DESCRIPTION

OF A

PORTABLE CHEST OF CHEMISTRY;

OR

COMPLETE COLLECTION

OF

CHEMICAL TESTS,

FOR THE USE OF

CHEMISTS, PHYSICIANS, MINERALOGISTS, METALLURGISTS, SCIENTIFIC ARTISTS, MANUFACTURERS, FARMERS, AND THE CULTIVATORS OF NATURAL PHILOSOPHY.

INVENTED BY

J. F. A. GOTTLING,

PROFESSOR OF CHEMISTRY AT JENA IN SAXONY.

TRANSLATED FROM THE ORIGINAL GERMAN.

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M.DCC.XCI.

PREFACE.

THE following ſheets are a tranſlation of the German original of M. *Gottling*, a diſciple of the celebrated *Wiegleb*, and advantageouſly known to the chemical world by ſeveral papers, publiſhed in *Crell's Chemical Annals*, and various other treatiſes. The teſts mentioned in the courſe of this work are prepared by Mr. *Hunneman*, a friend of the author, and pupil of the two great luminaries of chemical ſcience, Meſſrs. *Klaproth* and *Hermbſtaedt* of Berlin.

The

The cheſts are ſold completely fitted up at C. and G. Kearſley's, No. 46, Fleet-Street; where any article, that may be expended, will be replaced, on application being made to the above-mentioned bookſellers.

It is neceſſary to obſerve, that ſome deviations have been made from the author's original plan as given below; which, it is preſumed, will be thought improvements; particularly in the conſtruction of the cheſt itſelf, which is contrived in ſuch a manner, that all the different teſts may be ſeen at one view; the peſtle and mortar, the funnel, blow-pipe, and ſcales and weights being placed in a drawer at the bottom; and under this laſt article, the four different coloured papers.

It will be likewiſe proper to obſerve, that the empty phial is intended for the *Hepatic Water*, as well as *Hahneman's Wine-teſt*; as either of theſe teſts may at any time be made extemporaneouſly from the powdered cryſtals of tartar, and the calcareous liver of ſulphur.

If any farther explanation of the uſes to which theſe teſts may be applied is neceſſary, the reader is referred to *Wiegleb's Chemiſtry*, which will give him ample information on the ſubjects of every one of the departments mentioned in the latter part of this treatiſe.

ERRATA.

Page 10, *between line* 7 & 8 *insert* 13. Saccharine acid.
——————————— 15 & 16 —— 22. Litmus.

PART I.

EXPERIMENTS IN THE MOIST WAY.

INTRODUCTION.

WHEN in September, 1788, I announced* the portable Cheſt, which, according to the proſpectus, was to contain, *ready prepared for uſe, and in as pure a ſtate as poſſible*, the principal *re-agents* with which we have become acquainted in theſe latter times through the medium of Chemiſtry, and which are indiſpenſably neceſſary in the analyſing of bodies in the *moiſt way*; I promiſed to publiſh a ſet of inſtructions, in which the uſe of theſe teſts was to be explained in as diſtinct and perſpicuous a manner, as the nature of the ſubject would admit.

* In the *Chemical Almanack* or *Pocket Book* for 1789, a periodical work, publiſhed yearly by the author of this treatiſe. [E.]

It was long before I could reſolve upon what plan I ſhould purſue, in order that, while I was endeavouring to obtain the utmoſt brevity, I might loſe nothing in point of perſpicuity and clearneſs. To enter into a circumſtantial detail of every cauſe of the phenomena which in ſuch a variety of ways occur in the application of theſe teſts, would have required a complete introduction to Chemiſtry. But as I have great reaſon to ſuppoſe that thoſe, who intend to make uſe of this collection, are not without ſome tincture of chemical ſcience, I deemed ſuch a procedure unneceſſary, and thought it would be ſufficient to point out ſuch appearances as are liable to take place in every caſe, in which theſe teſts are combined with other ſubſtances. To this end I have made uſe chiefly of the writings of *Bergman**, *Struve*†, *Weſtrumb*‡, &c. but have conſtantly verified the doctrines advanced in them, by experi-

* Opuſc. Phyſ. et Chem. vol. i. pag. 93, &c.

† In the Supplements to the *Chemical Annals*, No. I. pag. 97 and 108; No. IV. pag. 82.

‡ Phyſico-chemical Eſſays, Part. I. No. II. and in the 2d and 3d part of theſe Eſſays, under the title of *Analyſis of mineral Waters*.

ments

ments which I have added of my own; and when I have found any little deviations from the truth, I have pointed them out. Every one therefore, by the repetition of these experiments with the tests contained in this collection, may immediately convince himself of the reality of the appearances attributed to them in this treatise, at the same time that he may apply the result of them to the investigation of bodies, and likewise use them as tests in any researches that he may have occasion to make. These experiments are followed by various objects of investigation, which may occur to Chemists, Physicians, Mineralogists, Metallurgists, projecting Artists, Manufacturers and Farmers; in which the tests here indicated are indispensably necessary, and where, in order to avoid unnecessary repetitions, I have constantly referred to the experiments that precede them.

Thus much indeed is allowed on all hands, that chemical investigations and analyses in the moist way, or those performed by means of menstrua and re-agents, are not the most exact, when the object is to determine the quantity of the constituent parts in any substance: but then they shew us, and that frequently with still

greater certainty than the reſearches in the dry way, without much loſs of time or expence, and when even a ſmall quantity only can be had of the product which is to be examined— they ſhew us, I ſay, whether that conſtituent part, which is ſuppoſed to be preſent, be really ſo or not, and whether it be worth while to ſet about inveſtigating it more in detail, be the body liquid or ſolid, artificial or natural, fixed or volatile.

But for ſuch reſearches, in which in many caſes exact reſults are wanted, theſe teſts muſt be as pure as poſſible, in order that no one, in the inveſtigation of bodies, may be induced, by heterogeneous ſubſtances mixed with theſe teſts, to draw falſe concluſions, and impute conſtituents parts to them, which, in fact, were never in them, till introduced by the teſt. Now theſe miſtakes and defective analyſes, the collection of re-agents, which I deliver ready for uſe in this cheſt, is intended in a particular manner to rectify; in the preparation of which I have been extremely careful, having examined them by every chemical principle that is yet known, and taken every method I could think of, to aſſure myſelf of their genuineneſs.

But any one who has been himſelf occupied with the preparation and purification of theſe teſts, will certainly know the difficulties with which they are attended, and will know beſides that, with all our exactneſs and care in the operations, ſtill it may happen, and that frequently by mere accident, that we ſhall be miſtaken, and that ſome ſcarcely perceptible portions of heterogeneous admixtures will ſtill adhere to the teſt, which will give riſe to fallacious appearances, and occaſion incorrect reſults. For this reaſon I ſhall eſteem it as a ſingular favour, if thoſe who have hitherto promoted this undertaking, and may perhaps ſtill be deſirous to promote it, would ſubmit the teſts, which I here offer to the public, to a ſevere examination, and point out to me every appearance which may indicate a defective mode of preparation. My principal endeavour will then be, to find out the defect, amend it, if poſſible, and bring theſe teſts nearer and nearer to perfection; becauſe I am well aſſured, that chemical inveſtigations and analyſes in general will gain by it very much in point of certainty and exactneſs.

In the experiments which I have made for

the ſake of illuſtrating the phenomena, every thing is determined by drops and grains, this being the ſmalleſt quantity that can be applied here in the eaſieſt manner. Any one, who wiſhes to know how much quicker or ſlower theſe teſts operate in a larger or ſmaller quantity, may either increaſe or diminiſh the quantity of diſtilled water, or, in the firſt caſe, uſe a greater number of drops or grains.

Having premiſed thus much, I now proceed to the conſtruction of the cheſt itſelf. It conſiſts of two ſeparate and neatly finiſhed boxes, but which may be joined together in ſuch a manner as conveniently to form one entire whole. A cheſt thus conſtructed is twelve inches long, nine inches high, and of the ſame breadth. The lower box, upon which the upper one is to be placed, contains fourteen phials and a glaſs mortar. The phials are all made of flint glaſs, and furniſhed with ground glaſs ſtoppers that fit them exactly; and each phial has a printed label affixed to it, expreſſive of its contents. In the lower box are contained:

1. Tincture of litmus.
2. Lixivium of Pruſſian blue.

3. Vitri-

3. Vitriolic acid.
4. Nitrous acid.
5. Marine acid.
6. Acetous acid.
7. Mild volatile alkali.
8. Mild vegetable alkali.
9. Highly rectified ſpirits of wine.
10. Lime-water.
11. Diſtilled water.
12. Calcareous liver of ſulphur.
13. Cryſtals of tartar in powder.
14. A phial for Dr. *Hahnemann*'s wine-teſt.

In the upper box, beſides a metal blow-pipe, a ſmall pair of ſcales, and a peſtle for the glaſs mortar, are contained 21 phials with the following articles:

1. Cauſtic vegetable alkali.
2. Cauſtic volatile alkali.
3. A ſolution of lead in acetous acid.
4. A ſolution of ſoap.
5. A ſolution of arſenic.
6. A ſolution of corroſive ſublimate in diſtilled water.
7. A ſolution of mercury in nitrous acid, prepared with the aſſiſtance of heat.
8. A ſolu-

8. A ſolution of mercury in nitrous acid, prepared without heat.
9. Volatile liver of ſulphur.
10. Spirituous tincture of galls.
11. Ponderous earth diſſolved in marine acid.
12. A ſolution of ſilver.
14. Purified ſal ammoniac.
15. Purified Epſom ſalt.
16. A ſolution of vitriol of copper.
17. Cuprum ammoniacum.
18. Quickſilver.
19. Mineral alkali.
20. Calcined borax.
21. Fuſible ſalt of urine.

At the ſide of the lower box moreover there is a ſmall drawer, and in this are contained:

1. Litmus paper.
2. Brazil-wood paper.
3. Turmeric paper.
4. Litmus paper reddened with vinegar.
5. A ſmall cylindrical glaſs.
6. A ſmall glaſs funnel.
7. Medical weights.

Concern-

Concerning the teſts contained in this collection, the following particulars are to be obſerved.

The tincture of litmus A loſes its blue colour very ſoon, and then becomes unfit to be uſed as a teſt; it is therefore neceſſary to have ſome genuine litmus in the collection*, in order to be able to prepare this tincture freſh, whenever it is wanted, as this can be done without much trouble, and the tincture is beſides in many caſes, eſpecially for the detection of fixed air, a more ſenſible teſt than litmus-paper.

Tincture of Litmus. A.

Put the litmus groſsly powdered into a clean rag; pour diſtilled water upon it in a wine-glaſs or tea-cup, and let it lie in the water till it has acquired the blue colour expected from it; if the rag be only ſqueezed a little under the water, the tincture will be made in a few minutes.

As the lime-water H, in conſequence of the

* As this drug is not ſo eaſily procured here as in the Author's country, Mr. H. has given it a place in the collection. [E.]

phial

phial being frequently opened, by which means the fixed air, that is uſually contained in the atmoſpheric air, has acceſs to it, is very apt to become turbid, depoſiting what is called Cream of Lime, or Mild Calcareous Earth, and can then be no longer uſed as a teſt; and as ſometimes there is more of it wanted for an experiment than is contained in the phial belonging to the collection, it may be prepared at any time and place, with very little trouble.

Lime-Water.

Upon three ounces of freſh-burned quicklime groſsly powdered, and put into a ſtrong glaſs bottle, provided with a good ſtopper, let a pound of moderately warm river-water be poured, by degrees, in order to prevent the bottle from cracking by the great heat that ariſes from the ſlaking of the lime. When the mixture is cold, cork the bottle well, and let it ſtand till it is become clear.

Although the lixivium of Pruſſian blue has been employed as a means of detecting iron in a liquid, yet its uſe remains ſtill problematical, if, as ſeems to be the caſe, it be not poſſible to free it from every particle of iron that adheres

heres to it, and to bring it to such a degree of perfection, that, by the mere addition of acids, no Prussian blue will be separated from it. The most celebrated chemists, such as *Beaumé*, *Macquer*, *de Morveau*, *Scopoli*, *Gianetti*, *Scheele*, *Klaproth*, *Struve*, *Bergman*, *Westrumb*, *Fourcroy*, *Woulfe*, *&c.* have endeavoured to free it entirely from iron; but their attempts have proved nothing else than the impossibility of effecting this purification. I myself could relate here more than fifty experiments, which I undertook merely for the sake of purifying this lixivium; and after all the pains I have taken, I am not come a jot nearer to the point; but rather think myself authorized to assert, on the strength of these very experiments, that when the purification of this lixivium is carried so far that acids separate no more Prussian blue from it, the lixivium is then entirely inefficacious as a test for iron.

Notwithstanding this impossibility of perfectly freeing the lixivium from iron, we might still be contented, if it could only be ascertained exactly how much iron is contained in a certain quantity of it, in order that this portion might then be deducted from the whole: but this is

attended

attended with almoſt as many difficulties as the purification itſelf. With reſpect to aſcertaining this point, M. *Weſtrumb** thinks to obtain his end, by calcining about fifty grains of the cryſtals of phlogiſticated alkali in a ſmall porcelain crucible, waſhing the reſiduum, collecting on a ſmall filtre the calx of iron that remains behind, edulcorating it perfectly, drying it, calcining it again for ſome hours, and, after having weighed it, marking on the phial, in which the phlogiſticated alkali is kept, how much calx of iron is contained in a hundred parts of this ſalt.

Now if this mode of determination was to be depended upon, theſe experiments, provided they are inſtituted under ſimilar circumſtances, and with the ſame phlogiſticated alkali, muſt neceſſarily always exhibit an equal quantity of calx of iron: but this is not conſonant to experience, for no one experiment affords the ſame quantity with another. Notwithſtanding all the care that can be taken, it is not poſſible, in the elixation, in the paſſing of the liquid through the filtre, and in the calcination, to prevent ſome particles of iron from being loſt. I have like-

* Phyſico-chemical Eſſays, Part. II. No. 2, pag. 228.

wiſe

wiſe made, with as much accuracy as poſſible, a conſiderable number of experiments with cryſtallized and phlogiſticated alkali, purified in the manner preſcribed by *Weſtrumb**. I undertook the calcination in ſilver crucibles, in porcelain, and in others made for the purpoſe of pure clay, ſometimes in the open fire only, ſometimes under the muffle of an aſſaying furnace: but none of all theſe experiments anſwered exactly to the others, with regard to the quantity obtained of calx of iron. In this uncertainty I deemed it loſs of time to continue theſe experiments any longer, and entirely gave up the idea, for the preſent, of the poſſibility of determining, by means of the lixivium of Pruſſian blue, the quantity of iron that is contained in a ſubſtance; eſpecially as my intention is merely to offer to the public ſuch teſts as indicate the preſence of a component part, and not the quantity of it that is preſent.

But yet we muſt retain the lixivium of Pruſſian blue for analyſes of this kind, becauſe it is the beſt means to ſeparate the iron from

* l. c. pag. 227.

a liquid,

a liquid, which, beſides this ſubſtance, holds earths in ſolution, in order to be able to ſeparate theſe earths afterwards devoid of iron. Now in order to effect this, the lixivium of Pruſſian blue muſt be entirely free from vitriolic acid, and perfectly ſaturated with its tinging matter; and to theſe qualities I have paid particular attention in the lixivium which I deliver with the cheſt.

As the *vegetable alkali* ſaturated *with ſaccharine acid* does not act differently from the ſaccharine acid itſelf; I have, in order to ſave room, omitted this ſalt in the cheſt, becauſe I afterwards found that the hepatic-water, or *Hahnemann*'s Wine-teſt, required three ſeparate phials in the collection.

As the *ſolution of lead in nitrous* and that in *acetous acid* act exactly alike as re-agents; I have alſo omitted one of theſe ſolutions in the collection, and inſtead of it inſerted Dr. *Hahnemann*'s Cuprum ammoniacum.

As the *Hepatic-water*, or Dr. *Hahnemann*'s *Wine-teſt*, ſoon loſes its effect as a teſt, by the phial in which it is kept being frequently opened; it is neceſſary that it ſhould be prepared afreſh, whenever it is wanted, from

the

the calcareous liver of ſulphur and cream of tartar contained in the collection, and water. This teſt acts differently in various reſpects, according to the greater or ſmaller quantity of cream of tartar employed in its preparation: for this reaſon I ſhall here give two different preſcriptions, and call one of theſe two compoſitions *Hepatic-water*, and the other the *Wine-teſt*.

No. I. *Hepatic-water*.

Having put ſixteen grains of calcareous liver of ſulphur and ten grains of cream of tartar in the phial appropriated to this liquid in the collection, fill it almoſt up to the top with diſtilled water; cork it well, ſhake the ingredients up together for the ſpace of ten minutes, and let the mixture ſtand till it is become clear. By this liquid all metals are precipitated with a more or leſs dark colour; but the iron, precipitated by it of a black colour, may be rediſſolved by vitriolic acid.

No. II. The *Wine-teſt*.

Having put ſixteen grains of calcareous liver of ſulphur and twenty grains of cream of tartar

into the phial, fill it in like manner almoſt up to the top with diſtilled water; the phial being well corked, ſhake the ingredients up together for the ſpace of ten minutes, and let them ſtand to ſettle. This liquor precipitates all metals that are prejudicial to health; while iron, that is perfectly harmleſs, is not precipitated by it.

In all the experiments, deſcribed in the following pages, perfectly pure diſtilled water muſt be employed; it may alſo be requiſite for the purpoſe of diluting perhaps a menſtruum, or for edulcorating any precipitate that may have been obtained by a previous proceſs. Now, for this purpoſe, there is a ſmall quantity only contained in the collection; as every one may prepare it himſelf with very little trouble, or it may be procured at the chemiſt's at a trifling expence.

If any of the articles, contained in this collection, ſhould be expended, I am willing to replace them upon the moſt reaſonable terms; on condition, however, of being reimburſed for the expences of carriage, poſtage, &c.

The more or leſs favourable reception this under-

undertaking meets with from the public, will determine me whether I ſhall venture to lay before it another ſtill more extenſive plan, of a ſimilar nature, though upon a ſomewhat larger ſcale. As reſearches in the moiſt way do not ſuffice for decompoſing bodies as completely as poſſible, and for determining the quantity of the conſtituent parts that are preſent, but, on the contrary, we are frequently obliged beſides to combine the dry mode of ſeparation with the moiſt; I intend that this firſt part ſhall be followed by a *ſecond*, which will contain the analyſes made in the *dry way*, and on occaſion of which I ſhall preſent to the Lovers of Chemiſtry a cheſt, containing the whole of the apparatus requiſite for the examination of bodies. Not only the analyſis of the ſubſtances belonging to the mineral kingdom will be treated of here, but my plan ſhall extend likewiſe to the analyſis of the *vegetable* and *animal kingdoms;* at the ſame time regard alſo ſhall be had to the *ſeparation of the artificial elaſtic fluids*, ſo that the whole may be conſidered as *a complete chemical Laboratory in miniature.* Undoubtedly a great number of experiments are yet neceſſary to be made, in order to apply the ap-

paratus, in the completeſt and moſt commodious manner, to every particular caſe that may occur. However, as ſoon as every difficulty, as well with reſpect to this circumſtance, as to providing the neceſſary apparatus, is overcome; I ſhall lay a plan of this undertaking before the friends and patrons of Chemical Science in a ſeparate proſpectus.

The Appearances, that occur during the Inveſtigation of Bodies by means of Re-agents, explained by Experiments.

A. *Tincture of Litmus.*

IF a liquid be impregnated with *fixed air*, or *any other acid*, the blue colour of this tincture will be changed by it to *red*. But if this redneſs is cauſed by fixed air, the mixture, on being ſlightly warmed, will become *blue* again, becauſe the fixed air being made to evaporate by the heat, leaves the tincture of litmus behind of its natural colour. The ſame reſult will take place, though ſomewhat more ſlowly, if the liquid is ſuffered to ſtand for ſome time in an open veſſel. If however the redneſs is occaſioned by any other of the more fixed acids

hitherto known, in this caſe the liquid, even after it is made warm, will remain red.

Experiment I.

Into a large wine-glaſs *, containing three or four ounces of pure *diſtilled water*, pour a few drops of the tincture of litmus, and the blue colour of this latter ſubſtance will not be altered.

Experiment II.

Impregnate a quantity of diſtilled water with *fixed air*, obtained by the uſual method from chalk and vitriolic acid, and to a wine-glaſs full of this water ſo impregnated add a few drops of the tincture of litmus; its blue colour will be changed immediately to *red*. The water thus reddened, on being made warm, by placing it near the fire, or by any other convenient method, will ſoon recover its former *blue colour*. The reſult will be the ſame, if this reddiſh li-

* Whenever a wine-glaſs is mentioned in the following pages, it is ſuppoſed to be of the very largeſt ſort in uſe in this country, which do not exceed in ſize the common wine glaſſes of Germany. The glaſſes commonly uſed for drinking cyder or ſtrong beer out of, may be likewiſe conveniently applied to this purpoſe. [E.]

quid

quid is merely ſet by for the ſpace of a night in an open veſſel.

Experiment III.

Having let fall into a wine-glaſs full of diſtilled water one drop of the pure *vitriolic acid*, or any of the other acids contained in the cheſt, add a few drops of the tincture of litmus to the mixture; the ſame *red colour* will be produced, and alſo remain *fixed* and *unaltered*, even though the mixture be made warm, or ſtand all night in an open veſſel.

B. *Litmus-paper.*

Paper coloured with litmus is liable to undergo the ſame change of colour, from the action of every acid liquor, as the tincture of litmus itſelf; and indeed in ſome reſpects it is even preferable to the tincture, as a *teſt for acids*; for, like this, it ſuffers no change of colour merely in conſequence of the acceſs of the fixed air, which is often contained in the atmoſphere. The tincture of litmus, on the contrary, ſoon becomes red by the frequent opening of the phial containing it, and can no longer be uſed as a reagent. It is alſo very liable to ferment, a pro-

ceſs, in conſequence of which the blue colour would be entirely deſtroyed.

Experiment IV.

Dip a piece of paper coloured with litmus into *pure diſtilled water*, and the blue colour of it will *not* be altered.

Experiment V.

Dip a piece of the ſame paper into a wine-glaſs full of diſtilled water, which has been previouſly impregnated with *fixed air* (Exp. II.), and in a few minutes the blue colour will be changed to *red*. Dry the paper thus reddened, by expoſing it to the air, and its priſtine *blue colour* will return, as faſt as the fixed air flies off from it.

Experiment VI.

Into a wine-glaſs full of diſtilled water having let fall one drop of vitriolic, nitrous, or muriatic acid, dip into it a piece of the above-mentioned paper, and the blue colour will in like manner be inſtantly changed to *red*. Take out the paper, and let it dry; the *blue* colour will *not* re-appear.

C. *Litmus-paper made red with vinegar.*

Litmus-paper made red with vinegar is a teſt of ſuch *alkaline ſalts* and *earths*, as are held in ſolution in any liquid by means of fixed air; for, by a liquid of this kind, the acetous acid, with which the paper was made red, is rendered inactive, and conſequently the *blue colour it exhibited at firſt* makes its appearance again. But, in order to know whether this change is produced in the paper by the preſence of an alkaline ſalt or of an earth, the liquid muſt be evaporated in a clean veſſel to one half. Now if the red colour continues ſtill to be diſcharged by the evaporation of the liquor, and the blue colour to be reſtored, there is an alkaline ſalt contained in it; for that part of the fixed air which holds the earth in ſolution is volatilized, and the earths that have been diſſolved by it are obliged to fall to the bottom, and then ceaſe to act upon the vinegar: the alkaline ſalts, on the contrary, in conſequence of their ſaline nature, remain diſſolved, and in this ſtate act alone upon the paper.

Experiment VII.

Suſpend a piece of litmus-paper, made red with

with vinegar, in a wine-glaſs full of diſtilled water, and the red colour will remain *unaltered.*

Experiment VIII.

Impregnate diſtilled water with fixed air, (Exp. II.) and diſſolve in it a few grains of pure *calcareous earth*; let the water ſtand till it becomes clear, and in a wine-glaſs full of this clear water ſuſpend a piece of reddened litmus-paper; the red colour will gradually diſappear, and the *blue* return. Let another portion of this water be evaporated to one half, and the liquor by degrees will become turbid; becauſe the calcareous earth, that was diſſolved in it, being deprived of its menſtruum, the fixed air is ſeparated in the form of a white powder. When the white powder is depoſited, and the water is become clear, ſuſpend in it another piece of the above-mentioned paper, and the *blue colour* now will be produced *no* more.

Experiment IX.

To a wine-glaſs full of diſtilled water add a drop or two of a ſolution of *aërated* or mild *vegetable alkali*, and dip a piece of the paper above-mentioned into it; immediately the *red* colour of it will

will *diſappear*, and its former blue colour ſhew itſelf again. Evaporate the water, as in Exp. VIII. and examine it anew with the reddened paper; *notwithſtanding this proceſs*, the *red* colour will diſappear, and the blue be reſtored.

Experiment X.

Let a grain of mineral alkali be diſſolved in a wine-glaſs full of diſtilled water; this ſolution will be ſeen to act upon the paper juſt in the ſame manner as the vegetable alkali did.

D. *Paper coloured with Brazil-wood.*

Paper coloured with the tincture of Brazil-wood, by the change of its colour from *red* to *violet*, indicates the preſence of an alkaline ſalt in any liquid: but ſince alſo, as was the caſe with the litmus-paper turned red by means of vinegar, the *earths combined with fixed air* produce this change of colours, it is neceſſary, with a view to aſſure one's ſelf of the preſence of an alkaline ſalt, for the liquid to be evaporated a little, as in C, in order to expel the fixed air, which holds the earths in ſolution, and to precipitate the earths, which will then be held in ſolution no longer. Now, if, after the evaporation, the red colour

colour of the paper is ſtill changed by the liquid to violet, it may be confidently concluded that this water contains an alkaline ſalt. But here M. *Hagen** makes this neceſſary remark, that the gypſum likewiſe, which may chance to be held in ſolution in a liquid, is capable of producing this change of colour, which alſo will ſtill happen, even if part of the liquid has been evaporated; becauſe there will always remain a portion of the gypſum diſſolved in the liquid, which is able to act upon the paper. The *paper* that is *coloured violet* by the *alkaline* ſalt, may yet be uſed as a teſt for *acids*; for, on the application of acids to it, the violet colour diſappears, and its former red colour is produced again.

Experiment XI.

Into a wine-glaſs full of *pure diſtilled water* dip a piece of the Brazil-wood paper, and the *red colour* of the paper will not be changed in the leaſt.

Experiment XII.

To a wine-glaſs full of diſtilled water add one

* In his *Chemical Analyſis of the Waters of Thuren in Pruſſia.* Konigſberg, 1789. (German.)

or

or two drops of a ſolution of *vegetable alkali ſaturated with fixed air*; into this ſolution dip a piece of the Brazil-wood paper, and the red colour of this latter will inſtantly be changed to *violet*.

Experiment XIII.

One grain of *mineral alkali* diſſolved in a wine-glaſs full of diſtilled water, produces with Brazil-wood paper the *ſame* effect as the vegetable alkali does. (Exp. XII.)

Experiment XIV.

Diſſolve in diſtilled water, impregnated with fixed air, a little pure calcareous earth, as in Exp. VIII. and let the water ſtand to ſettle. Into this clear water dip a piece of Brazil-wood paper, and the red colour will be changed by degrees to *violet*. Let another portion of the water be evaporated; the water will become turbid, the calcareous earth, which had been diſſolved, will be depoſited; and, if the trial be now repeated with the Brazil-wood paper, this latter will remain of a *red* hue, and no violet colour will appear.

Experiment XV.

In a clean phial, ſhake up for ſome minutes a few

a few grains of pure calcareous earth, with a little diſtilled water and a very few drops of vitriolic acid. The vitriolic acid will diſſolve the calcareous earth, and the gypſum, ariſing from this union, will remain diſſolved in the water. If the liquor be allowed to ſtand till it is clear, and a piece of Brazil-wood paper be dipped in it, we ſhall have a confirmation of M. *Hagen*'s obſervation (D); for the paper will by theſe means alſo contract a colour *inclining* to violet.

E. *Turmeric-paper.*

According to ſome late experiments, paper coloured with turmeric is greatly preferable to the other coloured papers, for the purpoſe of detecting the *alkaline ſalt* contained in any liquid, on account of its ſuffering *no* alteration from the earths combined with fixed air which may chance to be contained, together with the alkaline ſalt, in ſuch liquid. If therefore there be any alkaline ſalt in it, the yellow colour of this paper will be changed to *brown*. The *paper* thus *changed by alkaline ſalts* may now alſo be uſed as a *teſt for acids*; as, by the action of the acids, the brown colour diſappears again, and the *former yellow* colour is reſtored.

Experiment XVI.

Dip a piece of turmeric-paper into a wine-glaſs full of pure diſtilled water; the yellow colour will remain *unaltered.*

Experiment XVII.

Into the ſame quantity of diſtilled water having let fall one drop of the ſolution of mild or *aërated vegetable alkali,* in like manner dip a piece of this paper into it; after ſome hours the yellow colour of the paper will be found to be changed to *brown.*

Experiment XVIII.

In the ſame quantity of diſtilled water diſſolve one grain of *mineral alkali,* and dip a piece of this paper into the ſolution; the reſult will be the ſame as in Exp. XVII.

Experiment XIX.

Having impregnated a ſmall quantity of diſtilled water with fixed air, diſſolve in it a few grains of pure *calcareous earth.* (Exp. VIII.) Now if in this ſolution a ſmall ſlip of turmeric-paper is immerſed, the colour of this latter will undergo *no alteration.* The event will be the ſame

when

when the paper is dipped into a *ſolution of gypſum.* (Exp. XV.)

F. *Vitriolic acid.*

The vitriolic acid diſcovers, by a *ſlight effervescence*, the *preſence of fixed air* in an uncombined ſtate in a liquid, or the combination of this ſubſtance with *alkaline ſalts* or *earths.* If a liquid contain *a large quantity of calcareous earth* combined with fixed air, or with marine acid, and a few drops of vitriolic acid be let fall into it, and the veſſel containing the mixture ſet by for ſome time, cryſtals of ſelenite will by degrees fall out of it to the bottom of the veſſel. The vitriolic acid indicates alſo the preſence of *ponderous earth*, if this latter diſſolved in fixed air, or in the nitrous, muriatic or acetous acid, be preſent in any liquid; for, by virtue of its nearer affinity to this earth, it unites with it, and falls, as *ponderous ſpar*, to the bottom of ſuch liquid, in the form of a powder of difficult ſolution. If the exiſtence of nitrous acid combined with any other ſubſtance be ſuſpected in a liquid, in order to diſcover this, a few drops of vitriolic acid muſt be added, and the liquid be made hot: then if a ſtopper, moiſtened with

volatile

volatile alkali, be held over the heated liquid, *viſible* clouds will be produced, and the nitrous acid will by this means diſcover itſelf. The *marine acid* will produce the ſame appearance; but as this acts quite differently towards ſeveral other re-agents to be mentioned hereafter, the preſence of the latter is much ſooner diſcoverable.

Experiment XX.

To a wine-glaſs full of perfectly pure *diſtilled water* add a few drops of vitriolic acid; the mixture will take place quietly, and no *bubbles of air* will ariſe.

Experiment XXI.

Impregnate diſtilled water very ſtrongly with *fixed air* (Exp. II.), and to a wine-glaſs full of it add a few drops of vitriolic acid; *bubbles of air* will inſtantly ariſe, which will become more numerous on the liquor being ſtirred, and exhibit the appearance of a ſlight effervescence.

Experiment XXII.

Having impregnated a quantity of diſtilled water with fixed air, and diſſolved a few grains

of *calcareous earth* (Exp. VIII.) in it; add to this ſolution a few drops of vitriolic acid. The ſame appearance will now be perceived as in Exp. XXI. and if the liquid is ſuffered to ſtand at reſt for the ſpace of a night or longer, ſlender *cryſtals of ſelenite* will fall by degrees to the bottom of the veſſel.

Experiment XXIII.

Into a phial, together with a wine-glaſs full of diſtilled water, put a few grains of pure calcareous earth; to this add a few drops of marine or nitrous acid, and ſhake the whole well. A ſlight effervescence will enſue, and the calcareous earth will be diſſolved by the marine acid. As ſoon as the liquor is become clear, add a few drops of vitriolic acid to it, and ſet it by in a quiet place; after ſome time genuine *cryſtals of ſelenite* will fall to the bottom; becauſe the vitriolic acid, by virtue of its nearer affinity to the calcareous earth, combining with it, forms ſelenite, and the marine acid is by this means diſengaged.

Experiment XXIV.

To a wine-glaſs full of diſtilled water impregnated with a few drops of the *ſolution of ponderous*

rous earth S, add one drop of vitriolic acid; *white clouds* will immediately ariſe, and after ſome time genuine ponderous ſpar will fall to the bottom of the veſſel in the form of a white powder.

Experiment XXV.

Having diſſolved a grain or two of purified nitre in a wine-glaſs full of water, add ſome drops of vitriolic acid to it, and make the liquid hot; now if a glaſs ſtopper moiſtened with volatile alkali be held over the ſurface of this liquid, very viſible vapours will be ſeen to aſcend. A grain or two of common ſalt diſſolved in water, with a few drops of vitriolic acid added to it, will, under the ſame circumſtances, exhibit the ſame phenomena.

G. *Nitrous acid.*

The nitrous acid alſo, like the vitriolic, indicates by a *ſlight effervеſcence* the *preſence of fixed air* in any liquid which is to be examined. If a liquid contains *liver of ſulphur*, and a few drops of nitrous acid are added to it, a white precipitate enſues, accompanied with the uſual diſagreeable ſmell of rotten eggs. But if the liquid

be impregnated with hepatic air, no precipitate will be obtained; but the liquid, which was clear before, will loſe *its tranſparency in ſome degree* only; and the fetid ſmell, which, when any other acid is added, is very ſtrong, will here be *moderated.*

Experiment XXVI.

Into a glaſs full of *pure diſtilled water*, let fall a few drops of nitrous acid, and the *reſult* will be the ſame in every reſpect as in Exp. XX.

Experiment XXVII.

Impregnate, as in Exp. XXI. a ſmall quantity of diſtilled water with *fixed air*, adding, inſtead of the vitriolic acid, a little nitrous acid to it, and the ſame appearances will be obſerved as in Exp. XXI.

Experiment XXVIII.

Having let fall a drop of the *volatile liver of ſulphur* G G, into a wine-glaſs full of diſtilled water, add one drop of nitrous acid to it; in a ſhort time *white clouds* will be formed in the liquor, and by degrees a quantity of ſulphur of the ſame colour, accompanied by the fetid odour above mentioned, will ſubſide to the bottom. It

is not particularly neceſſary however to employ for this purpoſe the nitrous acid; for the vitriolic, marine, and acetous acids produce the *ſame* effect.

Experiment XXIX.

Having let fall into a wine-glaſs full of diſtilled water from ten to twenty drops of *Hahnemann's Wine-teſt* H H, add to the mixture a few drops of nitrous acid. *No white* precipitate will enſue, and the fetid odour, which this hepatic-water had before, will be *ſenſibly diminiſhed* by it.

H. *Lime-water.*

Equal parts of lime-water and of any liquid, that is to be examined, being mixed together, the mixture, if any *fixed air* is contained in it in an uncombined ſtate, will inſtantly become perceptibly turbid, becauſe the cauſtic or pure calcareous earth, which was held in ſolution in the lime-water, unites at that inſtant with the fixed air contained in the mixture, and falls in the form of aërated calcareous earth (or chalk) to the bottom of the veſſel. It is neceſſary to take *equal parts* of lime-water and of the liquid,

leſt the calcareous earth ſhould be rediſſolved by the fixed air that may chance to remain in the liquid, in like manner as ſome other ſalts of difficult ſolution in water; as for inſtance, vitriolated tartar and gypſum are readily taken up by water, when they are ſuperſaturated with an acid.

Some chemiſts, as for inſtance, the Profeſſors *Struve** and *Winterl*†, have endeavoured, by the quantity of the precipitate obtained by theſe means, to aſcertain the quantity of the fixed air contained in a liquid. Now were a liquid to contain no other fixed air than that which is in a diſengaged ſtate, ſomething might perhaps be determined by this method; but this being but very ſeldom the caſe, and mineral waters containing frequently, beſides fixed air, an alkaline ſalt or magneſia combined with vitriolic or marine acid, which likewiſe decompoſe the lime-water,—this mode of aſcertaining it is of courſe for the moſt part fallacious and uncertain; although M. *Struve* is of opinion that this

* Supplement to the Chemical Annals, vol. i. No. 4, p. 98.

† Analyſis Aquar. Buddenſium. Veterobudæ & Viennæ, 1781. p. 24.

defect

defect might be remedied by the farther examination of the precipitate.

Lime-water will alſo indicate the preſence of corroſive ſublimate in a liquid, by a *yellow or rather brick-duſt coloured precipitate*; and this colour will be more perfect, if the lime-water be added boiling hot to the liquid: a ſimilar appearance likewiſe is obſerved, when mercury diſſolved in nitrous acid is contained in a liquid. Dr. *Hahnemann** recommends alſo lime-water, eſpecially when it is uſed boiling hot, for detecting the preſence of *arſenic* in a liquid: it yields with this a *white precipitate of difficult ſolution* in water, of which one part requires two thouſand one hundred of cold water, to diſſolve it entirely. This precipitate is ſoluble in the acetous acid and a ſolution of arſenic, and mixed up with oil, and laid on red-hot coals, yields the well-known garlic-like ſmell of arſenic. If *copper* be contained in a liquid, the lime-water will precipitate it of a *green* colour. The *regulus of antimony*, when combined with a liquid in the form of emetic tartar, will be precipitated of a *white* colour.

* On the Effects of Arſenic as a Poiſon, the Remedies to be applied, and the Means of detecting it. Leipſic, 1786.

Experiment XXX.

With pure *diſtilled water* mix a little lime-water, and the mixture will remain *perfectly* limpid and clear.

Experiment XXXI.

Fill a two ounce phial up to the top with *fixed air*; to this add about half an ounce of lime-water, ſhake it well, and the lime-water will become perceptibly *turbid*. Pour this turbid water off, fill the phial anew with fixed air, put the turbid lime-water to it again, and ſhake it well; the liquid, which was turbid before, will immediately become *clear*; the mild calcareous earth, or chalk, that was formed, being rediſſolved by the redundant fixed air.

Experiment XXXII.

Having impregnated a quantity of diſtilled water with *fixed air*, add a ſmall proportion only of newly made lime-water to it; white clouds will immediately be formed, which however, on the mixture being ſhaken, will diſappear again. But if equal parts of water impregnated with fixed air and of lime-water are

mixed

mixed together, the water will become *turbid*, and remain ſo.

Experiment XXXIII.

To a wine-glaſs full of lime-water add one drop of the *mild* or *aërated vegetable alkali* O; the liquid will ſoon become turbid, and yield a white precipitate.

Experiment XXXIV.

Diſſolve a few grains either of *Epſom-ſalt* or *alum* in a wine-glaſs full of diſtilled water, and pour a little lime-water to the ſolution; it will become turbid, and a *flaky precipitate* will be gradually formed. The caſe will be the ſame with a ſolution of *magneſia* in the *nitrous* or *marine* acid.

Experiment XXXV.

Mix two or three drops of the *ſolution of corroſive ſublimate* Y, with half a wine-glaſs full of diſtilled water; no *yellow* nor *brick-duſt colour* will be produced, but the liquid will only become a little turbid, and of a whitiſh hue. If however twenty drops of the ſolution of corroſive ſublimate be mixed with half a wine-glaſs full of diſtilled water, and the glaſs be filled up with

with lime-water, the mixture will immediately exhibit a dark yellow colour, and after ſome time will depoſit a precipitate of the ſame hue. This experiment therefore ſhews that the ſolution of ſublimate muſt be tolerably ſtrong, in order to exhibit a *yellow*, or rather *orange colour*, with lime-water.

Experiment XXXVI.

Upon the *ſolution of mercury prepared by the aſſiſtance of heat*, lime-water acts much more powerfully. To half a wine-glaſs full of diſtilled water add one or more drops of the mercurial ſolution U, and fill up the glaſs with lime-water; a yellow precipitate will immediately be formed. It is probable that in ſmall portions of corroſive ſublimate lime-water does not produce this phenomenon, on account of the muriatic acid being ſuperſaturated; for if the experiment be repeated, by adding, before the addition of lime-water, one drop more of nitrous acid, the reſult of this experiment will be exactly the ſame as that of Exp. XXXV.

The *ſolution of mercury prepared in the cold*, X, acts in the ſame manner as corroſive ſublimate, becauſe in this, as well as in the corro-

ſive

ſive ſublimate, there is ſtill contained a redundant portion of acid.

Experiment XXXVII.

If a few drops of the *ſolution of arſenic* A A are mixed with half a wine-glaſs full of diſtilled water, and the remainder of it is filled up with freſh lime-water, the liquid will become turbid immediately, and a white *flaky precipitate* be depoſited. This phenomenon will take place ſtill quicker, when the lime-water has been previouſly made boiling hot. If the liquid is poured off clear from the precipitate, and to the latter are added a few drops of acetous acid, the precipitate will be completely rediſſolved: the reſult is the ſame, when a few more drops of the arſenical ſolution are added to it. If this precipitate is ſeparated, and, after being ſteeped in oil, laid upon red-hot coals, it will yield the uſual garlic-like odour of arſenic.

Experiment XXXVIII.

Into a wine-glaſs full of diſtilled water having put a few drops of a *ſolution of blue vitriol*, pour lime-water to the mixture, and a green precipitate will immediately take place.

Experi-

Experiment XXXIX.

Diſſolve one grain of *emetic tartar* in a wine-glaſs full of water, and add a little lime-water to it; a *white* precipitate will fall to the bottom, conſiſting of calx of antimony and tartareous ſelenite.

I. *Lixivium of Pruſſian blue.*

If a liquid holds *iron* in ſolution, by the intermedium of *fixed air*, or of *any other acid*, by adding a few drops of this lixivium to it, a *blue precipitate* will be formed, and fall by degrees to the bottom of the veſſel. But if the iron is diſſolved in fixed air, and the liquid is made warm, the fixed air (or aërial acid) will fly off, and the iron will fall to the bottom in the form of ochre. If the liquid, now become clear, after the ochre has ſubſided to the bottom, be examined afreſh, there will no more blue precipitate be produced by the addition of a few drops of the lixivium of Pruſſian blue. But if the iron is held in ſolution by any other acid, a *blue* precipitate will ſtill be formed on the addition of the lixivium of Pruſſian blue, even after the

the liquid has been warmed, or in part evaporated.

The ſeveral abſorbent *Earths* known at preſent, viz. *calcareous*, *magneſian*, *aluminous* and *ponderous earth*, if they are diſſolved in a liquid by the intermedium of any acid, will *not* be precipitated by the lixivium of Pruſſian blue, when this latter is perfectly ſaturated with the colouring matter, and contains no vitriolic acid. All *Metals*, on the contrary, which are held in ſolution in a liquid, will be precipitated by the Pruſſian alkali, and that moſtly with *different colours*. Even *acids alone* precipitate the Pruſſian blue from this lixivium, however carefully it may have been purified: but if the acids are in a very dilute ſtate, the blue precipitate does not appear immediately, but after a few days only; and this reſult will be accelerated by warming the liquid.

Experiment XL.

To a wine-glaſs full of *diſtilled water* add one drop of the Pruſſian lixivium, and *not the leaſt* alteration will be perceived.

Experi-

Experiment XLI.

Having impregnated a quantity of diſtilled water with *fixed air*, ſhake it up for ſome time with a few grains of clean *iron-filings*, and let it ſtand till the water is become clear. To a wine-glaſs full of this clear water add one drop of the Pruſſian lixivium; the liquid will become *blue* immediately, and after ſome time a *blue* precipitate will be depoſited. But if a little of the ſame quantity of the above water be evaporated, bubbles of air will make their eſcape, and a yellow ochre fall to the bottom. Then if, after the water is become perfectly clear, one drop of the Pruſſian lixivium be added, *no blue* precipitate will be formed.

Experiment XLII.

Shake four ounces of diſtilled water, a few grains of *clean iron-filings*, and one or two drops of vitriolic or marine acid together for the ſpace of a few minutes, and let the water ſtand till it becomes clear; or diſſolve a grain or two of martial vitriol in a little diſtilled water: to one half of this clear liquid add one drop of Pruſſian lixivium, and a *blue* precipitate will be formed

formed immediately. If the other half be evaporated a little, and one drop of Pruſſian lixivium be added, a *blue* precipitate will nevertheleſs be ſeen. It is true the ſolution of iron may alſo grow turbid during the evaporation, and a little ochre will be gradually depoſited; but for quite different reaſons from that in Exp. XLI; a certain portion, however, of the diſſolved iron will always remain behind, eſpecially if the evaporation be not performed too ſlowly.

Experiment XLIII.

Into different wine-glaſſes full of diſtilled water pour a few drops of a ſolution of *Magneſia* in the vitriolic, nitrous, marine or acetous acid; of a *ſolution of alum*; of *calcareous earth* in nitrous or marine acid; of *ponderous earth* in nitrous, marine or acetous acid:—to theſe ſeveral mixtures add a few drops of the Pruſſian lixivium, and they will *none of them* become turbid.

Experiment XLIV.

Into different wine-glaſſes full of diſtilled water pour a few drops of a *ſolution of copper, of ſilver, of mercury, of zinc, of lead, of biſmuth*, &c.

by

by the addition of a few drops of the Pruſſian lixivium, the copper will be precipitated of a *brown*, the biſmuth of a *brimſtone-yellow*, the mercury, ſilver, lead and zinc, of a *white* or *light-grey* colour.

Experiment XLV.

Into a wine-glaſs full of diſtilled water having poured a few drops of *vitriolic*, *nitrous*, or *marine* acid, add to the mixture a few drops of the Pruſſian lixivium, and no alteration of colour will take place. But if the liquid has ſtood quiet for ſome days, it will gradually aſſume a *blueiſh* hue, and in the ſpace of ſix or eight days, a few veſtiges of a *blue precipitate* will be viſible. The ſeparation of this blue precipitate will be accelerated by ſlightly warming the mixture.

K. *Spirituous tincture of galls.*

The ſpirituous tincture of galls indicates the preſence of *iron* in a liquid, by producing a *violet colour*; whether the iron be held in ſolution in ſuch liquid by fixed air or by any other acid. But if the iron be held in ſolution by fixed air, the liquid, upon being evaporated a little,

little, will no longer be tinged of a violet colour by this tincture; but if it be held in ſolution in a liquid by any other acid, the tincture of galls will ſtill produce this colour, even though the liquid have been ſomewhat evaporated.

Experiment XLVI.

To a wine-glaſs full of *diſtilled water* add one drop of the tincture of galls, and *no* alteration will be perceived.

Experiment XLVII.

Impregnate a quantity of diſtilled water with *fixed air*, ſhake it up for ſome minutes with a few grains of clean *iron filings*, and let the water ſtand till it is become clear; fill a wine-glaſs with this clear water, and add to it one drop of the tincture of galls; the above-mentioned *violet colour* will inſtantly appear. Let another portion of this water, impregnated with iron diſſolved by fixed air, evaporate in a warm place; bubbles of air will eſcape, a yellow ochre will fall to the bottom, and the remaining clear liquid will *no longer* be altered by the tincture of galls.

Experiment XLVIII.

To a ſmall quantity of diſtilled water add two drops of vitriolic or marine acid; and after ſhaking this mixture up for ſome minutes with a few grains of *pure iron-filings*, let the liquid ſtand till it is become clear.

To one half of this clear chalybeate water add one drop of the tincture of galls, upon which the *violet colour* will appear immediately. Heat the other half of the liquid till it boils, or let it evaporate a little, and examine it again by adding to it a few drops of the tincture of galls; the liquid will be ſtill of a *violet colour*. One grain of martial vitriol diſſolved in a wine-glaſs full of diſtilled water, will give the ſame reſults.

L. *Acid of ſugar.*

If *calcareous earth* diſſolved by fixed air or any other acid, be contained in a liquid; a few cryſtals of acid of ſugar thrown into it, will immediately render the *water turbid*, and a *ſaccharine ſelenite of difficult ſolution will fall to the bottom.* If the liquid contains but very little calcareous earth, it will not become turbid immediately,

mediately, but it muſt firſt be ſuffered to ſtand quiet for ſome time. Some pretend alſo to have obſerved that the acid of ſugar forms a ſalt as difficult of ſolution with the earth of *magneſia*, as it does with the calcareous earth, and therefore conſider the acid of ſugar as an uncertain teſt of the preſence of mere calcareous earth.

Experiment XLIX.

In a wine-glaſs full of *diſtilled water* diſſolve a few grains of the cryſtallized acid of ſugar, and the water will remain *perfectly clear*.

Experiment L.

Impregnate a ſmall quantity of diſtilled water with fixed air, ſhake the water up for ſome minutes with a few grains of *pure calcareous earth*, and let the water ſtand till it is become clear. In one half of this water diſſolve a grain of the acid of ſugar; the water will *immediately* become *turbid*, and after ſome time a white powder (ſaccharine ſelenite) will fall to the bottom. Make the other half of the water hot, during which proceſs a ſmall quantity of chalk will be depoſited by the exhalation of the fixed air; and the liquid, as ſoon as it is per-

fectly clear, will now *no longer* be rendered *turbid* by the ſaccharine acid.

Experiment LI.

Shake a ſmall quantity of diſtilled water, a few grains of *calcareous earth*, and a drop of nitrous or marine acid, for ſome minutes together, and let the liquid ſtand till it is become clear. Pour off a wine-glaſs full, and diſſolve in it a few grains of ſaccharine acid. The water will *immediately* become *turbid*, and a white powder will be depoſited at the bottom of the veſſel. Having evaporated a ſmall part of another portion of this water, examine it in like manner with the acid of ſugar, and it will exhibit the *ſame phenomena*. This will alſo be the caſe with a liquid that contains *Selenite*. (Exp. XV.)

Experiment LII.

Diſſolve two or three grains of *Epſom ſalt* in a wine-glaſs full of diſtilled water, as alſo a few grains of the ſaccharine acid; the liquid will *not* become *turbid*, but even on the day following continue to be tranſparent. This experiment ſhews that the earth of magneſia does not form a ſalt ſo difficult of ſolution as has been imagined

imagined with the ſaccharine acid, and that conſequently the preſence of this earth is no obſtacle to the detection of calcareous earth. If *ten grains or more of Epſom ſalt* are diſſolved in the above-mentioned quantity of diſtilled water, and to this ſeveral grains of ſaccharine acid are added, neither does the liquor become turbid, even though it have ſtood for ſome days.

M. *Acetous acid.*

The acetous acid is, according to Dr. *Dehne*'s experiments*, an excellent means of diſcovering the preſence of *volatile alkali* in a liquid. The outſide of a glaſs tube is to be moiſtened with this acid, and held over the ſurface of the liquid; if by this means fumes ariſe on the ſurface of the glaſs tube, it is a ſign of volatile alkali being preſent. Not only the acetous acid, but alſo a weak and not ſmoking nitrous acid, exhibits the ſame appearance.

Experiment LIII.

Hold over a glaſs full of pure *diſtilled water*

* Supplement to the Chemical Annals, 1786. No. 2. pag. 32.

 a ſtopper

a ſtopper moiſtened with concentrated vinegar, and *no fumes* or *clouds* will be viſible.

Experiment LIV.

Into a glaſs full of diſtilled water having put a few drops of a ſolution of *mild* or *aërated volatile alkali*, hold a glaſs ſtopper moiſtened with acetous, nitrous, or marine acid over it, and *immediately clouds* will be ſeen to aſcend.

N. *Cauſtic or de-aërated fixed vegetable alkali.*

If *earth* of *magneſia* held in ſolution by fixed air be contained in any liquid, it may be diſcovered by means of the cauſtic vegetable alkali; for a *white precipitate* will be produced by it *immediately*. But, according to *M. Weſtrumb*'s obſervations*, it has no perceptible effect upon other earths contained in liquids. *M. Hagen*†, however, is not entirely of *M. Weſtrumb*'s opinion on this point.—He allows indeed this ſalt to be the moſt perfect teſt of the preſence of earth of magneſia, but at the ſame time cannot

* In his Phyſico-Chemical Eſſays *(German)*, vol. i. part ii. pag. 96.

† l. c. pag. 16.

be

be perſuaded that *calcareous earth*, *pure aluminous earth*, and *iron* are entirely excluded from this privilege: it is upon ponderous earth only, according to him, that this ſalt has no effect; a poſition which had been already maintained before him by *Bergman**. The following experiments will determine this with ſomewhat greater accuracy.

Experiment LV.

To ſome *pure diſtilled water* add a few drops of the ſolution of cauſtic vegetable alkali, and the liquor will remain perfectly *tranſparent and clear*.

Experiment LVI.

Impregnate diſtilled water with fixed air (Exp. II.), diſſolve in it a few grains of pure earth of magneſia, and let the water ſtand till it is become clear; to this clear liquor add a few drops of the cauſtic vegetable alkali, and white clouds will immediately be formed.

Experiment LVII.

In a wine-glaſs full of diſtilled water diſſolve

* Opuſc. vol. i. pag. 99.

a few grains of *pure Epſom ſalt*, and add to it a few drops of the ſolution of cauſtic vegetable alkali; the liquor will *immediately become turbid*, and after ſome time there will be depoſited a white flaky pecipitate. A ſolution of *earth of magneſia* in nitrous or *marine* acid will give the ſame reſults.

Experiment LVIII.

In a wine-glaſs full of diſtilled water diſſolve one grain of *alum*; to this add one drop of the ſolution of cauſtic vegetable alkali, and the mixture will *not* be obſerved to become *turbid*; but if in this quantity of diſtilled water ten grains of alum are diſſolved, a white flaky precipitate will be formed in a ſhort time. This ſhews that *M. Weſtrumb*'s obſervation applies only, when a very ſmall quantity of alum is contained in a liquid: but in a ſomewhat larger quantity this ſalt certainly ſhews itſelf to operate upon the aluminous ſalts likewiſe.

Experiment LIX.

Shake ſome diſtilled water up with a few grains of *calcareous earth*, and two drops of vitriolic, nitrous, or marine acid for ſome minutes,

nutes, and let the liquor ſtand till it is become clear. To a wine-glaſs full of this liquor add one drop of the ſolution of cauſtic vegetable alkali; white clouds will immediately ariſe, owing to the calcareous earth, which is precipitated by it; but on the liquor being ſtirred, theſe clouds diſappear, for the precipitated calcareous earth is deprived of fixed air by the cauſtic alkali, and then remains diſſolved in the liquor, juſt as it is in the lime water. But if this liquor be expoſed to the air for ſome time, a thin cruſt of lime will appear on the ſurface, and the liquor itſelf become opake. This will take place ſtill quicker, if the liquor be poured into a phial filled with fixed air; by this means the calcareous earth acquires fixed air afreſh, and falls in the form of aërated lime or chalk (Exp. XXXI. and XXXII.) to the bottom of the veſſel.

Experiment LX.

To a wine-glaſs full of diſtilled water add one drop of the ſolution of ponderous earth S, and the cauſtic vegetable alkali will not render the mixture turbid. But if ten drops of this ſolution are mixed with the ſame quantity of diſtilled

led water; upon a ſolution of the cauſtic vegetable alkali being added, white clouds will appear, and after ſome time the ponderous earth, which is ſoluble in acids without any effervescence, will ſubſide to the bottom of the veſſel.

Experiment LXI.

Put a few grains of clean *iron-filings* into a phial, and ſhake them up for a few minutes with a little diſtilled water and *two drops* of *pure marine acid.* Let the water ſtand till it is become clear, and to a wine-glaſs full of it add one drop of the ſolution of cauſtic vegetable alkali; the liquid will immediately loſe its tranſparent colour, become yellow, and after ſome time depoſit a yellow ochre. If one grain of pure martial vitriol be diſſolved in diſtilled water, it will give exactly the ſame reſult.

O. *Fixed vegetable alkali ſaturated with fixed air.*

It is true, according to *Bergman*'s experiments*, the aërated or mild vegetable alkali precipitates all *Earths* and *Metals*, when they are held in ſolution in a liquid by means of an acid. But if the precipitate be eaſily diſſolved by fixed air, the de-aërated or cauſtic

* Opuſc. Phyſic. et Chem. tom. i. pag. 99.

vege-

vegetable alkali is to be preferred; for in this caſe the precipitate that is forming will frequently by means of a reciprocal or mutual affinity be rediſſolved in the liquid. If an *acid* be contained in a liquid, it may in like manner be diſcovered by the mild vegetable alkali; for in this latter caſe *bubbles of air* will ariſe (Exp. XXI.) if this alkali be added to ſuch liquids; becauſe the fixed air that is preſent is diſengaged by this means, and eſcapes with effervescence. In how far this alkali will ſerve as a teſt for corroſive ſublimate, ſee below in Exp. CIV.

Experiment LXII.

To a wine-glaſs full of perfectly pure *diſtilled water* add a few drops of the ſolution of mild vegetable alkali, and *not the leaſt* alteration will be perceived.

Experiment LXIII.

Prepare ſome *ſelenitic-water* (Exp. XV.), or add to a wine-glaſs full of *ſpring water containing gypſum*, a few drops of this alkali, and a precipitate will immediately be formed, which, when it has ſubſided to the bottom, will poſſeſs all the properties of common aërated calca-

calcareous earth or chalk. The ſame appearance will be perceived, if purſuant to Exp. LI. the calcareous earth be diſſolved in nitrous or marine acid, and a few drops of this alkali added to the liquid.

Experiment LXIV.

Diſſolve a few grains of *alum* in a wine-glaſs full of diſtilled water, and add to it a few drops of the above-mentioned alkali; the liquor will become turbid, and throw down an aërated earth of alum.

Experiment LXV.

Into a wine-glaſs full of diſtilled water put a few drops of the *ſolution of ponderous earth*, and add to it a few drops of the ſolution of this alkali; the liquor will become turbid, and let fall an aërated ponderous earth.

Experiment LXVI.

Diſſolve a few grains of the *Epſom ſalt* in a wine-glaſs full of diſtilled water, and add to it a few drops of the ſolution of the mild vegetable alkali. There will be no precipitation; or, if the liquor ſhould grow turbid, yet on being ſtirred it will become clear again; and this affords an

inſtance

inſtance in which magneſia, by means of the fixed air it contains, is rediſſolved by the liquid from which it was precipitated. But if the liquid be placed in a rather warm ſituation, the menſtruum which is here redundant, viz. the fixed air, will evaporate, and the magneſia make its appearance in the form of a white precipitate. A ſolution of magneſia in nitrous or marine acid, will give the ſame reſult.

That the metallic ſolutions are precipitated by the aërated or mild vegetable alkali, is proved by Exp. XCI. CXII. &c.

P. *Cauſtic or de-aërated volatile alkali.*

Cauſtic volatile alkali precipitates, beſides the calcareous and ponderous, all the other earths, as the earth of *magneſia*, of *alum*, and alſo of *iron*. According to *Weſtrumb* it precipitates the earth of iron almoſt in a *metallic* ſtate *; he therefore recommends it particularly for the purpoſe of ſeparating iron from its menſtrua. Beſides this, it imparts a *blue* colour to any liquid that contains copper in a ſtate of ſolution.

* Phyſico-chemical Eſſays, vol. i. part i. pag. 151. part ii. pag. 97.

Experi-

Experiment LXVII.

To a wine-glaſs full of *diſtilled water* add a few drops of cauſtic volatile alkali, and *no* alteration will be perceived.

Experiment LXVIII.

Into a clean phial put a few grains of *calcareous earth* with diſtilled water, and a few drops of vitriolic, marine, or nitrous acid, and let the water ſtand till it is become clear; to this clear liquor add a drop or two of cauſtic volatile alkali, and it will not become turbid for the ſame reaſons as in Exp. LIX.

Experiment LXIX.

To a wine-glaſs full of diſtilled water, impregnated with a few drops of a *ſolution of ponderous earth*, add one drop of the above-mentioned alkali, and no precipitate will be formed: in this it coincides with calcareous earth. (Exp. LXVIII.)

Experiment LXX.

Diſſolve about a grain of *alum* in a wine-glaſs full of diſtilled water, and add one drop of this alkali

alkali to it; after ſome time *white flakes* will appear. The reſult will be the ſame from a few grains of *Epſom ſalt* diſſolved in diſtilled water, or a ſolution of magneſia in nitrous or marine acid.

Experiment LXXI.

A ſolution of iron made according to Exp. LXI. and mixed with cauſtic volatile alkali, gives the ſame reſult as that Experiment; but that the iron is ſeparated here *nearly in a metallic ſtate*, I have not obſerved.

Experiment LXXII.

Let fall a drop or two of the ſolution of *vitriol of copper* into a wine-glaſs full of diſtilled water; to this add a few drops of the cauſtic volatile alkali, and the liquid will immediately be tinged perceptibly *blue*.

Q. *Mild aërated volatile alkali.*

According to *Weſtrumb**, volatile alkali ſaturated with fixed air ſerves, by means of a double affinity, to ſeparate all *Earths*, which may chance

* l. c. pag. 97.

to be contained in a liquid. Beſides, it may ſerve in like manner to diſcover the preſence of *copper* in a liquid, by the blue colour it imparts to the latter.

Experiment LXXIII.

To a wine-glaſs full of *diſtilled water* add one drop of the ſolution of this alkali, and *no* alteration will be perceived.

Experiment LXXIV.

Prepare as in Exp. LXVIII. a *ſolution of calcareous earth*, and add to it a few drops of mild volatile alkali; *white clouds* will immediately be formed, which will diſappear on the liquor being ſtirred, becauſe the fixed air which is contained in it rediſſolves them: warm the liquid; and the fixed air, that holds the calcareous earth in ſolution, will fly off, and the calcareous earth will be depoſited in the form of chalk or crude calcareous earth. A few drops of the ſolution of ponderous earth mixed with diſtilled water, will be affected by this alkali in the ſame manner.

Experiment LXXV.

Diſſolve a few grains of the *Epſom ſalt* in a wine-glaſs full of diſtilled water, and add a few drops of the volatile alkali to it; the liquor will remain perfectly clear, and no precipitate be formed; if the liquor be warmed, every thing will turn out as in Exp. LXVI. *A ſolution of magneſia* in *nitrous* or *marine acid* gives the ſame reſult.

Experiment LXXVI.

Mix one or two drops of the ſolution *of vitriol of copper* with a wine-glaſs full of diſtilled water, and add a drop or two of the volatile alkali to it; a *light blue* or rather *greeniſh* precipitate will be formed, which, on the addition of more volatile alkali, will be rediſſolved with a ſapphire blue colour.

R. *Solution of Soap.*

If liquids be impregnated with *fixed air* or any other acid, or with *earthy* or *metallic neutral ſalts*, ſoap will be decompoſed by it, and a *flaky precipitate* will be formed; in earthy or metallic neutral ſalts, this ſeparation takes place in virtue of a double affinity.

Experiment LXXVII.

Mix a wine-glaſs full of pure *diſtilled water* with a drop or two of the ſolution of ſoap; and *no* alteration will be perceived.

Experiment LXXVIII.

Having impregnated a ſmall quantity of diſtilled water with *fixed air*, or a few drops of any other acid, to this water add a few drops of the ſolution of ſoap; it will immediately become turbid, and throw down a number of *white flakes*.

Experiment LXXIX.

Having impregnated a ſmall quantity of diſtilled water with fixed air, diſſolve in it a few grains of *calcareous earth*, or *earth of magneſia*, and after the liquid is poured off clear from the earth that may chance to remain undiſſolved in it, add to it a few drops of the ſolution of ſoap; and in like manner *white flakes* will be formed in abundance, and this by means of a mutual affinity; the alkali of the ſoap combining with the fixed air, and the unguinous part with the earth, forming an earthy ſoap.

Experi-

Experiment LXXX.

Diſſolve a few grains of *Epſom ſalt* or *alum* in a wine-glaſs full of diſtilled water, and add to it a few drops of the ſolution of ſoap; ſoon afterwards the water will become turbid, and depoſit a number of *white flakes* which may be explained on the ſame principle as Exp. LXXIX. Any of the other earths held in ſolution in a liquid, will give the ſame reſult; for inſtance, the *ſelenitic water* in Exp. XV. and a ſolution of calcareous earth, or of magneſia in nitrous or marine acid.

Experiment LXXXI.

Mix any *metallic ſolution*, ſuch as that of ſilver, copper, lead, iron or mercury, &c. with a wine-glaſs full of diſtilled water, and add to it a few drops of the ſolution of ſoap: this will in like manner become turbid, and a great number of white flakes will be depoſited at the bottom of the veſſel: the ſame degree of affinity operates here as in Exp. LXXIX. and LXXX.*

* *Brandis* Commmentatio de Oleorum Unguinoſorum Natura. Gottingae, 1785, § 21—32.

S. *Solution of ponderous earth in marine acid.*

This ſolution of ponderous earth is extremely well adapted to diſcover the preſence of *vitriolic acid* either in a diſengaged ſtate or combined with *any other* ſubſtance in a liquid; becauſe the ponderous earth is particularly diſpoſed to forſake its menſtruum, unite immediately with the vitriolic acid, and form with it a precipitate of very difficult ſolution; viz. *genuine ponderous ſpar*, Exp. XXIV. If there be too ſmall a proportion of vitriolic acid in the mixture, it will be ſome time before the ſeparation takes place; it is better therefore to let the liquid ſtand a little, in order to wait for the ſeparation, or to evaporate the liquid a little, and then examine it again with the ſolution. Beſides, as it is pretty accurately determined, that an hundred *grains* of this precipitate contain thirteen *grains* of vitriolic acid, entirely free from water, the quantity of vitriolic acid, contained in a liquid, may in ſome meaſure be diſcovered by this means.

Now, according to *Weſtrumb**, this ſolution

* l. c. p. 100.

produces

produces a *reddiſh-brown* precipitate in any liquid that holds *liver of ſulphur* or *hepatic air* in ſolution.

Experiment LXXXII.

To a wine-glaſs full of *diſtilled water* add a few drops of the ſolution of ponderous earth, and *no* alteration will be perceived.

Experiment LXXXIII.

Into a wine-glaſs full of diſtilled water let fall one drop of the *vitriolic acid* F. and to this add one drop of the ſolution of ponderous earth; *white clouds* will inſtantly be formed, and a white inſoluble precipitate, which is an artificial ponderous ſpar, will be gradually depoſited at the bottom of the veſſel.

Experiment LXXXIV.

Having diſſolved a grain of the *Epſom ſalt* D. D. in a wine-glaſs full of diſtilled water, add to it one drop of the ſolution of ponderous earth, and the ſame appearance will be perceived as in Exp. LXXXIII. The ſame reſult will take place, if the liquid holds *Gypſum*, *Alum* or *Vitriol* in ſolution. If, inſtead of Epſom ſalt, two

or three grains of *Glauber's ſalt*, or of *vitriolated tartar*, are diſſolved in diſtilled water, the ſame appearances will take place: but the remaining liquid will be of a different nature; for, inſtead of marine ſalt with baſis of magneſia, it is genuine *marine ſalt*, or *ſal digeſtivum Sylvii*.

Experiment LXXXV.

Having let fall a drop of the *volatile liver* of *ſulphur* G. G. into a wine-glaſs full of diſtilled water, add to it one drop likewiſe of the ſolution of ponderous earth; the liquor will become turbid, and after ſome time will depoſit, not a *reddiſh brown*, but a *whitiſh grey* precipitate.

Experiment LXXXVI.

Into a wine-glaſs full of diſtilled water let fall ten drops of *Hahnemann's wine-teſt*; upon adding to it one drop of the ſolution of ponderous earth, a precipitate ſimilar to that mentioned in Exp. LXXXIV. will fall to the bottom of the veſſel.

T. *Solution of ſilver in nitrous acid.*

The ſolution of ſilver in nitrous acid is an excellent teſt of the *vitriolic* and *marine acids*.

But

But as the alkaline ſalts and earths likewiſe precipitate ſilver from its ſolution, the alkaline ſalts and earths, which may chance to be contained in ſuch a liquid, are to be previouſly ſaturated with a few drops of the pure nitrous acid. Now if a liquid contains *vitriolic acid*, or any *ſalt appertaining to that genus*, there will be formed, according to *Weſtrumb**, a *white cryſtalline powder*, that is ſoluble in nine hundred parts of water: but if the liquid contains marine acid, or *any of the ſalts into the compoſition of which this acid enters*, a *white flaky precipitate* will be formed, that is ſoluble in the nitrous and acetous acid. Theſe acids however, or their reſpective ſalts, ſeldom occurring alone in a liquid, but for the moſt part mixed with others; the precipitates produced by them are commonly mixed likewiſe, and the difference between them is difficult to be determined.

According to *Weſtrumb*†, a *black* precipitate alſo will be produced by the ſolution of ſilver, if the liquid contains *liver* of *ſulphur* or *hepatic air*. This chemiſt has likewiſe obſerved, that

* l. c. p. 101. † l. c. p. 101.

the ſolution of ſilver is capable of producing a dark colour in conſequence of the action of *extractive matter* upon it—the *air* of *marſhes* and *inflammable vapours*. And farther, when the vitriolic and marine acid have been previouſly ſeparated by the ſolution of ponderous earth and of lead, the quantity of *mucilaginous matter* alſo exiſting in a liquid may be diſcovered by means of the ſolution of ſilver; for when a liquid contains this ſubſtance, a few drops of the ſolution afford a precipitate, three grains of which contain two grains of mucilaginous matter.

Experiment LXXXVII.

To a wine-glaſs full of *diſtilled water* add one drop of the ſolution of ſilver, and *no* alteration will take place.

Experiment LXXXVIII.

If a few drops of *vitriolic acid* are mixed with a wine-glaſs full of diſtilled water, and a few drops of the ſolution of ſilver added to it, in like manner there will be no precipitate produced, but the mixture will be rather of an opal

opal hue. After ſome time the water will acquire a *reddiſh* caſt, and in the ſpace of a few days a precipitate of *this colour* will be depoſited,

Experiment LXXXIX.

Let fall a drop of pure *marine acid* into a wine-glaſs full of diſtilled water, and to this add one drop of the ſolution of ſilver; a *white precipitate* will immediately be produced, which ſome time after will acquire a blueiſh appearance; but the precipitate will not be rediſſolved by the addition either of nitrous or of acetous acid.

Experiment XC.

Take two wine-glaſſes full of diſtilled water; in the one diſſolve a grain of *Epſom ſalt*, *Glauber's ſalt*, or *vitriolated tartar*; in the other a grain of *common ſalt*, *ſal ammoniac*, *calx ſalita*, or *magneſia ſalita*; and the appearances which are perceivable here, will be perfectly ſimilar to thoſe of Exp. LXXXVIII. and LXXXIX. A ſelenitic water (Exp. XV.) or one grain of alum diſſolved in diſtilled water, will give juſt the ſame reſult as Exp. LXXXVIII.

Experi-

Experiment XCI.

Let a few drops of the ſolution of the *mild vegetable alkali* O. fall into a wine-glaſs full of diſtilled water, and to this add a few drops of the ſolution of ſilver; a white precipitate will immediately be produced. Again, mix a few drops of the alkaline ſolution with another wine-glaſs full of diſtilled water, but add ſo much of the nitrous acid G. to it, till the alkaline ſalt is perfectly ſaturated with it; now if into this liquor a few drops are put of the ſolution of ſilver, it will not be obſerved to become turbid.

Experiment XCII.

Having impregnated a ſmall quantity of diſtilled water with fixed air, diſſolve a few grains of *calcareous earth* in it, and let the water ſtand till it is become clear. To one half of this tranſparent liquid add one drop of the ſolution of ſilver; the liquid will be tinged of a *reddiſh* hue, and after ſome time a precipitate of the ſame colour will ſubſide to the bottom of the veſſel. The calcareous earth, that is contained in the other half of the tranſparent liquid, ſatu-

rate with the pure nitrous acid; and now add a few drops again of the ſolution of ſilver, and, as in Exp. XCI. the liquid will *not* become *turbid.* The obſervation therefore of *Bergman** and *Weſtrumb*†, according to which even earths combined with fixed air decompoſe the ſolution of ſilver, is confirmed by this experiment.

Experiment XCIII.

Into a wine-glaſs full of diſtilled water having let fall one drop of the *volatile liver of ſulphur* G. G. add to this a drop of the ſolution of ſilver; *clouds of a light-brown colour* will immediately be formed, and after ſome time a precipitate of the ſame hue will be depoſited at the bottom of the veſſel. The reſult will be the ſame alſo with the ordinary liver of ſulphur.

Experiment XCIV.

Into a wine-glaſs full of diſtilled water having let fall ten drops of *Hahnemann's wine-teſt* H. H. add to it one drop of the ſolution of ſilver, the liquid will not become *brown* quite *ſo ſoon*

* Opuſc. Phyſic. et Chem. vol. i. p. 102.

† l. c. part ii. p. 101.

as

as in Exp. XCIII.; but after some time a visibly *brown precipitate* will appear.

U. *Solution of mercury or quicksilver in nitrous acid, prepared with the assistance of heat.*

If a liquid contains *marine* acid, or *neutral, earthy or metallic salts, composed of the marine acid,* by the addition of this mercurial solution a *white precipitate* will be produced in abundance. In like manner the *vitriolic acid,* or its *neutral, earthy or metallic salts,* when they happen to be present, yield with this solution a *white precipitate,* which however will become *yellow* in boiling hot water. If *mild vegetable alkali* be present in a liquid, this mercurial solution produces with it a precipitate of a *yellowish white colour.* But in order that the aërated earths, which may happen to be contained at the same time in a liquid, may not act upon the mercurial solution, a few drops of pure nitrous acid are previously to be mixed with it. If such liquid contains *liver of sulphur* or *hepatic air,* the mercurial solution indicates this also by a *brownish-coloured* precipitate. If iron united with vitriolic acid be present, a *brimstone-coloured* precipitate is immediately formed.

Experi-

Experiment XCV.

To a wine-glaſs full of *diſtilled water* add one drop of the mercurial ſolution, and *no* alteration will be perceived. But if the diſtilled water is impregnated with *mucilaginous particles*, ſmall white clouds are produced in conſequence of this ſolution being added; a circumſtance which *Bergman** obſerved, when he had diſſolved three grains of cherry-tree gum in three quarts of *diſtilled water*.

Experiment XCVI.

Having let fall a drop of *marine acid* into a wine-glaſs full of diſtilled water, and added one drop of this mercurial ſolution, *white clouds* will immediately appear, and a precipitate of the ſame colour will ſubſide to the bottom of the veſſel. The reſult will be the ſame, when marine or common ſalt, or any earthy combination with the marine acid, is employed.

Experiment XCVII.

Into a wine-glaſs full of diſtilled water having let fall one drop of *vitriolic acid*, add to this

* Opuſc. vol. i. p. 103.

one

one drop of the mercurial ſolution; *yellowiſh clouds* will immediately be formed in the liquor, and by degrees a precipitate of the ſame colour will be depoſited. The clear part of the liquor being poured off, the yellow hue will, by the addition of freſh warm water, be ſtill perceptibly heightened. The ſame appearance will be perceived, if a grain or two of *Epſom ſalt*, or any *vitriolic, neutral, earthy or metallic ſalt*, as for inſtance, *Glauber's ſalt, vitriolated tartar, alum, ſelenite*, (Exp. XV.) are diſſolved in the ſame quantity of diſtilled water, and one drop of the ſolution of quickſilver is added to the mixture.

Experiment XCVIII.

Into a wine-glaſs full of diſtilled water having let fall one drop of the *mild vegetable alkali* O. to this add a few drops of the *ſolution* of *quickſilver*; clouds of a *yellowiſh white colour* will inſtantly be produced, and the mixture, if ſet by, will depoſit a precipitate of the ſame colour. If in the above-mentioned quantity of diſtilled water a grain of *mineral alkali* is diſſolved, on the addition of this ſolution, the ſame appearances will be perceived.

Experi-

Experiment XCIX.

Into a wine-glaſs full of diſtilled water having let fall a drop or two of the *volatile liver of ſulphur* G. G. to this add one drop of the ſolution of quickſilver; clouds of *a darkiſh yellow colour* will be produced, and likewiſe after ſome time a precipitate of the ſame hue will be depoſited at the bottom of the veſſel.

Experiment C.

If a few drops of *Hahnemann's wine-teſt* H. H. are mixed with a wine-glaſs full of diſtilled water, and to this one drop of the ſolution of quickſilver is added, *clouds* of a *dirty yellow hue inclining* to *brown* will in like manner appear, and after ſome time a precipitate of the ſame colour will be depoſited at the bottom of the veſſel.

Experiment CI.

Into a wine-glaſs full of diſtilled water let fall a drop or two of vitriolic acid, and ſhake this mixture up for the ſpace of ſome minutes with a few grains of *clean iron filings*; or diſſolve a grain of pure martial vitriol in a wine-

glaſs

glaſs full of diſtilled water; the water having ſtood till it is become clear, add to it a drop of the ſolution of quickſilver, and in a ſhort time a *beautiful yellow* precipitate will be obtained, which, in my opinion, is nothing but a vitriol of mercury, or *Turpeth mineral*, as the greateſt part at leaſt of the diſſolved iron is ſtill to be found in the remaining liquid; for after the yellow precipitate in this experiment has perfectly ſubſided, a few drops of the tincture of galls, added to the liquid remaining upon the precipitate, indicate, by the violet colour they impart to it, that iron is yet contained in it: and this the following experiment with the marine acid ſeems ſtill more to confirm; for though no vitriol of mercury is formed here, yet ſome particles of the iron that is contained in the mixture may in like manner give the precipitate a yellowiſh tinge.

Experiment CII.

Having mixed a few drops of a ſaturated ſolution of *iron in marine acid*, with a wine-glaſs full of diſtilled water, add to it a few drops of this ſolution of quickſilver; a precipitate will ſoon appear, and the clear liquid being poured off,

off, and a few drops of the tincture of galls added to it, it will in like manner be found that the iron is ſtill preſent in the liquid, and has no ſhare in the precipitate that has been formed.

X. *Solution of quickſilver prepared without heat.*

This ſolution of quickſilver does not hold ſo much quickſilver in ſolution as the other, and, according to *Bergman**, the quickſilver has loſt leſs of its phlogiſton, than it would if the ſolution had been made by heat. Now it is on this account that this ſolution reacts ſomewhat differently from the other: this difference is principally ſeen in the different effects of the ſolution upon the *mild* and *cauſtic vegetable alkalies*; for here much brighter colours are produced than by that ſolution which was prepared with heat. But in moſt caſes the effect is the ſame with that prepared by heat, which will be ſeen if the Experiments from XCV. to CII. are repeated with this ſolution, and the quantity of the added ſolution is at the ſame time ſomewhat increaſed. How the ſolutions

* Opuſc. Phyſ. et Chem. vol. i. p. 102.

of quickſilver U. and X. act upon lime-water, ſee in Experiment XXXVI.

Y. *Solution of corroſive ſublimate.*

Liquids containing *vegetable alkali* united with fixed air produce with the ſolution of corroſive ſublimate an orange-coloured precipitate. *Calcareous earth combined with fixed air* ſhews itſelf, according to *Weſtrumb**, by a *white* precipitate. He has alſo obſerved, that when a liquid contains *liver* of *ſulphur*, or *hepatic-air*, it produces with the ſolution of corroſive ſublimate, in the firſt inſtance a *black*, and in the ſecond a *white* precipitate.

Experiment CIII.

To a wine-glaſs full of pure *diſtilled water* add a few drops of the ſolution of corroſive ſublimate, and *no* alteration will be perceived.

Experiment CIV.

Let fall one drop of the ſolution of mild vegetable alkali O. into a wine-glaſs full of diſtilled water, and add to it one drop of the ſolu-

* l. c. p. 105.

tion

tion of corrosive sublimate; after some time the liquid will become turbid, and deposit a *white precipitate*. The same appearance will be perceived, if with a glass full of this mercurial water two, three, four, five, six, seven or eight drops of the alkali are mixed; upon nine drops being added, several yellow clouds are formed, and ten drops produce the *orange-coloured precipitate* in full perfection.

Experiment CV.

One grain of *mineral alkali* being dissolved in a wine-glass full of distilled water, and one drop of the solution of corrosive sublimate added to it, a *white* precipitate is produced; five grains dissolved in the same quantity of water, yield an *orange-coloured* precipitate, as in Exp. CIV.

Experiment CVI.

Into a wine-glass full of distilled water let fall one drop of *volatile liver of sulphur* G. G. and to this add one drop of the solution of corrosive sublimate; clouds of a *whitish yellow* colour will immediately be formed, which grow darker and darker, and after some time a *red-*

diſh-brown precipitate will be depoſited at the bottom of the veſſel.

Experiment CVII.

Mix ten drops of *Hahnemann's wine-teſt* H. H. with a wine-glaſs full of diſtilled water, and to this mixture add a few drops of the ſolution of corroſive ſublimate; a *precipitate of a dark yellow colour inclining to brown* will be formed, ſimilar to that of Exp. CV.

Experiment CVIII.

In order to know if the ſolution of corroſive ſublimate will likewiſe produce a *white precipitate* with *earths diſſolved in fixed air*, impregnate a little diſtilled water with fixed air, and in this menſtruum diſſolve a few grains of calcareous earth. Let the water ſtand till it is become clear; and to a wine-glaſs full of this tranſparent fluid add a few drops of the ſolution of corroſive ſublimate, and *no white* precipitate will appear. The aërated calcareous earth therefore does *not* act upon the ſolution of corroſive ſublimate. Aërated magneſia diſſolved in diſtilled water is in the ſame predicament; but if the water is ſtrongly ſaturated with calcareous

earth or magnesia, a precipitate may be produced, on warming the liquid, as by this means the menstruum, *viz.* the fixed air, is volatilized. How the solution of corrosive sublimate acts with respect to lime water, see in Exp. XXXV

Z. *Solution of sugar of lead in distilled water.*

By this vegeto-saturnine solution the presence of *vitriolic* or *marine* acid, or of the *neutral salts* composed of them, is discovered by a *white precipitate*, of which that precipitate, which is produced by the marine acid, is soluble in vinegar; that produced by the vitriolic acid, on the contrary, is not. But to prevent the alkaline salts and earths combined with fixed air, which may happen to be contained in a liquid, from acting here as precipitants, add previously to the liquid a few drops of nitrous acid, in order to saturate them and render them inactive. A liquid containing *liver of sulphur*, or *hepatic air*, yields with the solution of sugar of lead a more or less *dark-coloured* precipitate.

Experiment CIX.

To a wine-glass full of *distilled water* add one

 drop

drop of the vegeto-ſaturnine ſolution, and *no* alteration will take place.

Experiment CX.

Into a wine-glaſs full of diſtilled water let fall one drop of *vitriolic acid;* to this add one drop of the ſolution above-mentioned, and a *white precipitate* will immediately be formed. Prepare a ſelenitic-water, as in Exp. XV. or diſſolve a grain of *pure Epſom ſalt*, *alum*, or any other neutral vitriolic ſalt, ſuch as *Glauber's ſalt*, *vitriolated tartar*, &c. in the above quantity of diſtilled water; add one drop of the ſolution of ſugar of lead to it, and the reſult will be the ſame in every reſpect as with the vitriolic acid. *A hundred grains* of vitriol of lead contain, according to *Bergman**, twenty-eight grains of vitriolic acid.

Experiment CXI.

The ſolution of ſugar of lead is not ſo well adapted for diſcovering a *ſmall portion of marine acid*, or of the *neutral ſalts compoſed of it*, as it is for detecting vitriolic acid. If one drop of *ma-*

* Opuſc. vol. i. p. 104.

rine

rine acid be let fall into a wine-glaſs full of diſtilled water, and one drop of the ſolution of ſugar of lead added to it, no alteration will be perceived; and five drops of the acid being mixed with the above-mentioned quantity of water, the reſult will be the ſame; neither will any alteration be ſeen on the addition of ten, twenty, thirty, forty and even fifty, drops. But ſixty drops of marine acid being mixed with a wine-glaſs full of diſtilled water, and a little of the ſolution of ſugar of lead added to it, will render the liquor turbid, and ſmall cryſtals will be gradually depoſited at the bottom of the veſſel, which are neither ſoluble in the acetous nor in the nitrous acid. The appearances produced by common ſalt and the different combinations of the earths with the marine acid and the ſolution of ſugar of lead, are not very different from thoſe produced by the marine acid. After collecting the precipitate together, and drying it, pour a little diluted acetous acid upon it, and it will be diſſolved.

Experiment CXII.

Having let fall a drop or two of the *mild vegetable alkali* O. into a wine-glaſs full of diſ-

tilled water, add to it a few drops of the ſolution of ſugar of lead, and a copious *white* precipitate will immediately be formed. To another wine-glaſs full of diſtilled water add a drop or two of the alkali, and pour on it ſo much of the *nitrous acid* G. till the alkali contained in the mixture is ſaturated with it; on the addition of the vegeto-ſaturnine ſolution, *no* precipitate will now appear; and even if a white cloud or two ſhould be perceived, they will be rediſſolved upon the liquor being ſtirred. The aërated calcareous earth and magneſia, when preſent in a liquid, produce the ſame appearances.

Experiment CXIII.

Having impregnated a wine-glaſs full of diſtilled water with one drop of the *volatile liver of ſulphur* G. G. add to it a drop of the vegeto-ſaturnine ſolution; clouds of a *dark-brown colour* will immediately appear, and a precipitate of the ſame colour will be depoſited at the bottom of the veſſel.

Experiment CXIV.

Ten drops of *Hahnemann's wine-teſt* H. H. mixed

mixed with a wine-glaſs full of diſtilled water, exhibits, with the addition of one drop of the vegeto-ſaturnine ſolution, the ſame appearance as Exp. CXIII.

A. A. *Solution of arſenic in diſtilled water.*

The ſolution of arſenic is excellently well adapted for diſcovering the preſence of liver of ſulphur, or hepatic-air, in a liquid. If therefore to a liquid, containing liver of ſulphur or hepatic-air, a little of this ſolution of arſenic is added, a more or leſs *yellow* colour will be produced; and if there be much ſulphur in the mixture, a *yellow precipitate* will be depoſited.

Experiment CXV.

Let fall a few drops of the ſolution of arſenic into a wine-glaſs full of pure *diſtilled water*, and *no* alteration will be perceived.

Experiment CXVI.

Having let fall one drop of the *volatile liver of ſulphur* G. G. into a wine-glaſs full of diſtilled water, to this mixture add a few drops of the ſolution of arſenic; the liquid will immediately become turbid, *yellow clouds* will be produced,

duced, and after ſome time a precipitate of the ſame colour (viz. Orpiment) will ſubſide to the bottom of the veſſel.

Experiment CXVII.

Let fall ten drops of *Hahnemann's wine-teſt* H. H. into a wine-glaſs full of diſtilled water, and to this add a few drops of the ſolution of arſenic: at firſt the lower part of the liquor will be coloured *yellow*; but on being ſtirred, the whole will acquire the ſame colour, and after ſome time a yellow precipitate likewiſe will be depoſited, juſt as in Exp. CXVI.

B. B. *Mercury, or Quickſilver.*

According to *Weſtrumb's** experiments, quickſilver alſo is an excellent teſt for diſcovering the preſence of *ſulphur* in a liquid. A little quickſilver, that is pure and entirely free from duſt on its ſurface, is to be put into the liquid, which muſt be ſuffered to ſtand quiet for ſeveral hours. Now if the liquid contains ſulphur combined *in any manner whatſoever*, the mercury will loſe its *metallic ſplendor*,

* l. c. p. 107.

will become more or leſs *refractory and ſolid*, and more or leſs of a *red* or *black* colour.

Experiment CXVIII.

Into a clean phial filled with diſtilled water put a little mercury, and let it ſtand for ſome time; the mercury will retain the whole of its metallic ſplendor.

Experiment CXIX.

Into a clean phial that holds three ounces of water, put one drop of the *volatile liver of ſulphur* G. G. with three ounces of diſtilled water, and throw into the mixture a little bright and perfectly pure mercury; in a ſhort time the mercury will loſe its ſplendor, and its ſurface will be covered with a *brown* or *black* pellicle.

Experiment CXX.

In like manner mix ten drops of *Hahnemann's wine-teſt* with four ounces of diſtilled water, and put to the mixture a little pure quickſilver; the reſult will be in every reſpect the ſame as in Exp. CXIX.

C. C. *Pure*

C. C. *Pure Epſom ſalt.*

As the earths, that are held in ſolution in a liquid by means of fixed air, are not decompoſed by pure Epſom ſalt, this latter has been recommended as a teſt for diſcovering the *alkaline ſalts* which may chance to be contained in a liquid, becauſe the pure Epſom ſalt is decompoſed by the alkali, and the magneſia is ſeparated: but when the portion of alkaline ſalt contained in a liquid is but ſmall, this teſt cannot well be applied; as, for a precipitate to be formed here, the alkali muſt be in a cauſtic ſtate, and in this ſtate it is perhaps very ſeldom to be met with in any liquid that is to be examined. But if it be combined with fixed air, the earth of magneſia, by virtue of a double affinity, unites with this latter, and then remains by its means, as in Exp. LXVI. diſſolved in the liquid. When however this teſt is applied, it is neceſſary to heat the liquor, by which means the fixed air is volatilized, and the magneſia ſeparated.

Experiment CXXI.

In a wine-glaſs full of pure diſtilled water diſſolve a few grains of pure Epſom ſalt, and *no* alteration will be perceived.

Experi-

Experiment CXXII.

Into a wine-glaſs full of diſtilled water let fall a drop or two of *mild* or *aërated vegetable alkali*; or diſſolve in this quantity of water a few grains of *mineral alkali*, and add to the mixture a few grains of the pure Epſom ſalt; the Epſom ſalt will diſſolve, and no precipitate will be perceived. But heat the mixture with a very gentle heat, and immediately *white flakes* will be ſeparated, which will diſſolve in any acid that is added to them, with efferveſcence, on account of the fixed air remaining combined with them. But if the *cauſtic alkali* N. is mixed with diſtilled water, and a few grains of pure Epſom ſalt are afterwards diſſolved in this ſame water, a precipitate appears immediately, which is alſo ſoluble in acids, but without efferveſcence, on account of the precipitated magneſia being deprived of its fixed air. See Exp. LVII.

D. D. *Sal ammoniac.*

According to ſome well-known experiments, ſal ammoniac diſcovers the *alkaline particles* contained in a liquid in two different ways: *in the firſt place, by the augmentation of cold*, which it

it produces in a liquid when there is an alkaline ſalt in this latter, and which muſt be determined by a ſenſible thermometer; and *ſecondly*, by the *extrication of the volatile alkali*, which, by means of the fixed alkali contained in the liquid, is, in conſequence of the nearer affinity of the fixed alkali to the marine acid, ſeparated and ſet at liberty; and this latter proof, eſpecially if the quantity of the fixed alkali be but ſmall, is to be preferred in every reſpect to the firſt.

Experiment CXXIII.

Having diſſolved a few grains of pure ſal ammoniac in a wine-glaſs full of *pure diſtilled water*, hold a ſtopper moiſtened with acetous acid over the liquor; and *no vapour* will be ſeen to aſcend.

Experiment CXXIV.

Into a wine-glaſs full of diſtilled water let fall one drop of the ſolution of *mild vegetable alkali* O. or diſſolve in this quantity of diſtilled water two grains *of mineral alkali*, and to the ſolution add a few grains of ſal ammoniac: over the ſurface of this liquid hold a ſtopper with nitrous, marine or acetous acid, not in a fuming

fuming ſtate; and the aſcent of a *rare vapour* or *cloud* will indicate the ſeparation of the volatile alkali, by means of the fixed alkali that was contained in the mixture: this appearance will be perceived ſtill more diſtinctly, if the liquid be warmed a little. With this compare Exp. LIV.

E. E. *Solution of vitriol of copper.*

Alkaline ſalts contained in a liquid may be diſcovered by means of the ſolution of blue vitriol. The earths alſo that are held in ſolution in liquids by means of an acid, will be rendered viſible by this means. The vegetable alkali manifeſts itſelf by a *dark ſea-green* colour; the mineral alkali by a *bright apple-green*; magneſia produces with it a *dark apple-green*; calcareous earth, a *yellowiſh green*; and earth of alum, a colour ſimilar to that of *verdegris*. But theſe appearances are not to be truſted to; as, with reſpect to the different ſhades of colours it produces, a miſtake may eaſily be committed*. If arſenic be contained in a liquid, a *yellowiſh green colour (Scheele's green)* is produced by the addition of

* *Weſtrumb*, l. c. p. 98.

this

this ſolution. The preſence of ſulphur alſo, or of liver of ſulphur, in a liquid may be inferred, if by this means a *blackiſh brown colour* is produced.

Experiment CXXV.

To a wine-glaſs full of *diſtilled water* add one drop of the ſolution of blue vitriol, and *no* alteration will be perceived.

Experiment CXXVI.

Into a wine-glaſs full of *diſtilled water* let fall a drop or two of the ſolution of *vegetable alkali* O. or diſſolve two grains of *mineral alkali* in the above-mentioned quantity of this water, and add to the mixture a few drops of the ſolution of vitriol of copper; green *clouds* will immediately be formed, and after ſome time a precipitate of the ſame colour will be depoſited at the bottom of the veſſel.

Experiment CXXVII.

A few drops of the ſolution of *mild volatile alkali* Q. being mixed with pure diſtilled water, and a few drops of this vitriolic ſolution added to it, a *green* precipitate is produced, which, with regard

regard to colour, is not very different from that of Exp. CXXVI; but if more of the volatile alkaline ſolution be added to it, the former green precipitate will be entirely diſſolved, and this liquid will acquire as in Exp. LXXII. a fine *ſapphire blue* colour.

Experiment CXXVIII.

In a wine-glaſs full of diſtilled water diſſolve a grain of the *pure Epſom ſalt* C. C. and add to it a few drops of the ſolution of blue vitriol; ſoon after, clouds of a *pale green colour* will appear, and after ſome time a precipitate likewiſe of the ſame hue will be depoſited at the bottom of the veſſel. A ſolution of magneſia in nitrous or marine acid will give the ſame reſult.

Experiment CXXIX.

Prepare a ſelenitic water (Exp. XV.), or a ſolution of *calcareous earth in nitrous or marine acid* (Exp. LI.), and add to it a few drops of this vitriolic ſolution; *clouds of a pale green colour* will in like manner be formed, but verging more to yellow than thoſe mentioned in Exp. CXXVIII.

Experiment CXXX.

Diſſolve a *grain or two of alum* in a wine-glaſs full of diſtilled water, and add to the ſolution a few drops of the ſolution of blue vitriol; a green precipitate will be formed with a ſmall tinge of blue in it; but the blue caſt of this precipitate may proceed from the alum being ſeldom entirely free from volatile alkali.

Experiment CXXXI.

Let fall a few drops of the *ſolution of arſenic* A. A. into a wine-glaſs full of diſtilled water, and to this add a few drops of the ſolution of vitriol of copper; clouds of a *yellowiſh green colour* will appear, and after ſome time a ſimilar precipitate (*Scheele's green*) will be depoſited at the bottom of the veſſel.

Experiment CXXXII.

Into a wine-glaſs full of diſtilled water let fall a drop or two of *volatile liver of ſulphur* G. G. and add to it a few drops of the ſolution of vitriol of copper; clouds of a *blackiſh brown hue* will immediately be formed, and after ſome time

time a precipitate of the ſame colour will fall to the bottom.

Experiment CXXXIII.

Ten drops of *Hahnemann's wine-teſt* H. H. mixed with a wine-glaſs full of diſtilled water, to which a few drops of the ſolution of vitriol of copper are added, produce a *blackiſh brown* precipitate, perfectly ſimilar to that of the preceding Experiment.

F. F. *Cuprum ammoniacum.*

The Cuprum ammoniacum is recommended by Dr. *Hahnemann** as an excellent means of diſcovering arſenic in a liquid; for it produces with it a *yellowiſh green* precipitate (*Scheele's green*), which, if ſeparated from the ſuperincumbent liquor, dried, and put upon ignited coals, manifeſts itſelf by the garlic-like ſmell peculiar to arſenic. This precipitate is not ſoluble in water alone, nor in the ſolution of arſenic, but in cauſtic volatile alkali and in acids†.

Experiment CXXXIV.

To a wine-glaſs full of pure diſtilled water add

* l. c. p. 239. † l. c. p. 238.

one drop of the ſolution of cuprum ammoniacum; the water will acquire a *blue colour*, but it will not become turbid, nor will any precipitate be formed.

Experiment CXXXV.

Into a wine-glaſs full of diſtilled water let fall a drop or two of *the ſolution of arſenic* A. A. and add to it a few drops of the ſolution of cuprum ammoniacum; a yellowiſh green precipitate will immediately enſue, which, if collected, dried, and put upon ignited coals, diffuſes around a ſmell of garlic. According to *Hahnemann**, two hundred and ſixty-ſeven grains of this precipitate contain one hundred and ſixty-two grains of copper, and one hundred and ſixty-five grains of arſenic. Divide the whole of the liquid, together with the yellowiſh green precipitate, into four parts, and add to one a little diſtilled water only; to the ſecond, a little of the arſenical ſolution; to the third, a little cauſtic volatile alkali; and to the fourth, a few drops of vinegar, or of any other acid contained in the collection. On the addition of water only, *no*

* l. c. p. 238.

alteration

alteration will be perceived, any more than from the arſenical ſolution; but the cauſtic alkali will *immediately diſſolve* the precipitate, and exhibit a perfectly tranſparent liquid, of a ſapphire blue colour; and the acid added to the fourth part will in like manner diſſolve the precipitate.

G. G. *Volatile liver of ſulphur.*

By means of the volatile liver of ſulphur any acid contained in an uncombined ſtate in a liquid may be diſcovered; for, on the addition of a few drops of this liver of ſulphur, a *white precipitate of ſulphur* will be produced. If *arſenic* be held in ſolution in a liquid, it will be manifeſted by the *yellow*, or, if it contains much arſenic, *red* colour of the liquid, and by the appearance of a precipitate of the ſame hue. If a liquid holds regulus of antimony in ſolution, it will be precipitated by this ſolution, of an *orange colour*, in the form of *golden ſulphur of antimony*, or *Kermes* mineral. But beſides, according to *Weſtrumb**, by this liver of ſulphur there is produced, with liquids that hold *iron* or *copper* in ſolution, a *black*, and with ſuch as contain ponderous earth, a *brown* colour.

* l. c. p. 238.

Experiment CXXXVI.

To a wine-glaſs full of pure *diſtilled water* add a few drops of volatile liver of ſulphur, and the mixture will *not* become *turbid.*

Experiment CXXXVII.

Into a wine-glaſs full of diſtilled water let fall a drop or two of *any acid*; and if a few drops of this liver of ſulphur are added to it, a white precipitate of ſulphur (Exp. XXVIII.) will be inſtantly formed.

Experiment CXXXVIII.

Into a wine-glaſs full of diſtilled water let fall a few drops of the *ſolution of arſenic* A. A. Upon adding a few drops of the volatile liver of ſulphur to it, the ſame appearance will be perceived as in Exp. CXVI.

Experiment CXXXIX.

Diſſolve a grain of *emetic tartar* in a wine-glaſs full of diſtilled water, and add to it a few drops of the liver of ſulphur above mentioned; an *orange colour* will immediately appear in the liquor, and a precipitate of the ſame hue will be depoſited, which upon nearer examination will

will be found to be a *golden ſulphur of antimony*, or *Kermes mineral*. A ſimilar precipitate will appear, if to a few drops of *butter of antimony* a drop or two is added of the volatile liver of ſulphur diluted with diſtilled water.

Experiment CXL.

Prepare as in Experiment XLII. a *vitriolic chalybeate water*, or elſe diſſolve one grain of *vitriol of iron* in a wine-glaſs full of diſtilled water. To this chalybeate water, which is perfectly tranſparent, add a few drops of the volatile liver of ſulphur, and a *black* precipitate will immediately appear; if to this black precipitate a few drops are added of the vitriolic acid F. it will be *perfectly rediſſolved*, and the black colour will entirely *diſappear*.

Experiment CXLI.

Into a wine-glaſs full of diſtilled water let fall a few drops of the ſolution of *vitriol of copper*, and to the mixture add a few drops of this liver of ſulphur; the reſult will be the ſame in every reſpect as in Experiment CXXXII. If to this precipitate of copper a few drops of vitriolic acid are added, it will not diſappear as in

Experiment CXL. but remain unaltered. For the action of the volatile liver of ſulphur upon *ponderous earth*, *ſilver*, *mercury*, and *lead*, when any of them are held in ſolution in a liquid, ſee the Experiments LXXXV. XCIII. XCIX. CVI. and CXIII. None of theſe precipitates are capable of being rediſſolved by the addition of vitriolic acid.

H. H. *Hahnemann's wine-teſt, or Water impregnated with hepatic air.*

This hepatic-air water, which for experiments ought always to be prepared freſh from the calcareous liver of ſulphur and cream of tartar contained in the collection, according to the receipt No. I. or No. II. given in the introduction, differs from the volatile liver of ſulphur, in *not* rendering *turbid*, liquids that contain uncombined acids. According to Dr. *Hahnemann** it is an excellent means of diſcovering *arſenic* that is held in ſolution in a liquid, by the yellow colour that takes place on this occaſion. The production of this colour is accelerated by acids, and prevented by alkaline

* l. c. p. 246.

ſalts.

ſalts. *Iron* is precipitated perfectly black by it; and the precipitate is, as in the caſe of the volatile liver of ſulphur, *rediſſolved* by vitriolic acid. Upon *lead*, *copper*, and *moſt* other *metals*, this hepatic-air water acts like the volatile liver of ſulphur: none of theſe metallic precipitates are ſoluble again in vitriolic acid. The ſolution of *regulus of antimony* is precipitated by it of an *orange colour*, in the ſame manner as by the volatile liver of ſulphur.

Experiment CXLII.

To a wine-glaſs full of pure *diſtilled water* add a few drops of hepatic-air water, and *no* alteration will be perceived.

Experiment CXLIII.

Into a wine-glaſs full of diſtilled water having let fall a few drops of any of the *acids* contained in the collection, to this add a few drops of the wine-teſt; and the mixture, juſt as in Experiment XXIX. will *not* be perceptibly turbid.

Experiment CXLIV.

Into a wine-glaſs full of diſtilled water let fall a few drops of the *ſolution of arſenic* A. A.

and

and add to it a little of the hepatic-air water; ſoon after this addition the liquor will acquire a *golden* colour, and after ſome time a precipitate of the ſame hue (viz. orpiment) will be depoſited at the bottom of the veſſel. The production of this yellow colour is *accelerated* by adding a few drops of the acetous acid M. but on the addition of a few drops of the alkaline ſolution O. the *yellow colour* will *entirely diſappear*. If this yellow precipitate be dried, and thrown upon red-hot coals, at firſt a *ſmell of ſulphur* will be perceived, and afterwards of *arſenic*.

Experiment CXLV.

To a little of the *chalybeate* water prepared according to Exp. CXL. or to a wine-glaſs full of diſtilled water holding a grain of *pure vitriol of iron* in ſolution, add a few drops of the wine-teſt; immediately a *black precipitate* will be formed as in Exp. CXL. which will *diſappear* again on the addition of a few drops of the vitriolic acid F.

Experiment CXLVI.

Into a wine-glaſs full of diſtilled water let fall a few drops of the *ſolution of lead*, and in like manner an *almoſt black precipitate* will be pro-

duced, which, on the addition of vitriolic acid, will *not* be redissolved. Compare with this Exp. CXIV.

Experiment CXLVII.

If a few drops of the *solution of vitriol of copper* E. E. are put into a wine-glass full of distilled water, and a few drops of the wine-test added to it, a precipitate of a *blackish brown* colour will be produced, which, just as was the case in Exp. CXLI. will *not* disappear on the addition of vitriolic acid.

Experiment CXLVIII.

Having dissolved one grain of *emetic tartar* in a wine-glass full of distilled water, to this add a few drops of the wine-test; an *orange-coloured precipitate* will be produced as in Exp. CXXXIX. In the same manner will this wine-test act upon *butter of antimony*.

For the action of the wine-test upon *ponderous earth*, *silver*, and *mercury*, see Experiments LXXXVI. XCIV. C. CVII. According to Dr. *Hahnemann**, corrosive sublimate produces with hepatic-air water a *yellowish brown* colour, which

* l. c. p. 241.

after-

afterwards turns to *white*. This latter circumſtance I have not found; the precipitate exhibited a *yellowiſh brown*, and retained this colour unchanged even for ſome days afterwards. See Exp. CVII.

I. I. *Highly rectified ſpirit of wine.*

According to *Weſtrumb** all the vitriolic neutral ſalts are ſeparated from a liquid, by mixing with it equal parts of this ſpirit of wine. When added to a liquid in a larger proportion, it alſo ſeparates the ſaline neutral ſalts compoſed of nitrous and marine acid; but not the *metallic* or *terrene* ſalts compounded of theſe acids. If in the ſeparation of theſe ſalts, by means of vinous ſpirit, ſufficient care be taken, many other ſorts of ſalts likewiſe that are contained in a liquid may be ſeparated by it from each other, after being reduced by evaporation to a ſolid ſtate; becauſe many ſalts are ſoluble in ſpirit of wine, while others again are inſoluble†. Beſides theſe,

* l. c. p. 110.

† Wenzel's Doctrine of the Affinities of Bodies. Dreſden, 1782, p. 428. Lavoiſier's Phyſico-chemical Eſſays, vol. ii. p. 143.

reſinous

reſinous and æthereo-oily ſubſtances may alſo be extremely well ſeparated by means of ſpirit of wine.

Experiment CXLIX.

Diſſolve three grains of the *pure Epſom ſalt* C. C. in a quarter of an ounce of diſtilled water, and add to it an equal quantity of highly rectified ſpirit of wine. The mixture will become turbid, and by degrees ſmall *cryſtals of Epſom ſalt* will be formed at the bottom of the glaſs. This vinous ſpirit will alſo act in the ſame manner upon other ſaline liquids, e. g. ſuch as hold *vitriolated tartar*, *Glauber's ſalt*, *nitre*, &c. in ſolution.

Experiment CL.

Mix a few grains of *diuretic ſalt*, or *foliated earth* of *tartar*, with a few grains of *vitriolated tartar*; put them into a phial furniſhed with a ſtopper that fits it well, and after pouring a little ſpirit of wine upon them, ſet the mixture in a warm place: the diuretic ſalt will be diſſolved by the ſpirit, and the vitriolated tartar remain undiſſolved behind. Separate the liquor carefully from the vitriolated tartar, and evaporate the

vinous ſpirit: by this means the diuretic ſalt will be left behind in a ſeparated ſtate. To the ſalts which are ſoluble in ſpirit of wine may chiefly be referred beſides, *common ſalt with a calcareous baſis*, *common ſalt with baſis of magneſia*, *nitre with baſis of magneſia*, *nitre with a calcareous baſis*, &c.

Experiment CLI.

Mix one grain of *reſin of jalap*, or of any other *reſin* ſoluble in ſpirit of wine, with a few grains of vitriolated tartar, or with any other ſubſtance that is inſoluble in ſpirit of wine, and pour as in Exp. CL. a little of the vinous ſpirit upon them; the reſin will be diſſolved in the ſpirit, and the ſalt will remain undiſſolved behind. Pour off the liquor carefully, and, by adding diſtilled water to it, ſeparate the reſin.

Experiment CLII.

Mix a few drops of oil of almonds, or of the beſt ſallad oil, with a few drops of any æthereal oil, as for inſtance, *oil of cloves*, and pour ſpirit of wine upon it; the oil of cloves will diſſolve in the ſpirit, and the oil of almonds remain undiſſolved behind. Endeavour to pour

off

off the ſpirituous part of the liquor from the oil of almonds, and add diſtilled water to the former: the water will now unite with the ſpirit of wine, and by this means the oil of cloves will be ſeparated.


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The Use of the Collection to Chemists, Physicians, Mineralogists, Metallurgists, projecting Artists, Manufacturers, Farmers, and the Cultivators of Natural Philosophy.

I.

The uſe of the collection to Chemiſts.

THE Chemiſt muſt neceſſarily be acquainted with all the re-agents that are contained in this collection, and their different effects; he alſo knows the ſources from whence he may procure the information neceſſary for his reſearches; and, as he occupies himſelf with reſearches of every kind, whether they appertain to *medical Juriſprudence*, *Mineralogy*, *Metallurgy*, the *Arts*, or *rural Oeconomy*, it is not ne-

ceſſary,

ceſſary, in this place, to direct his attention to particular caſes.

II.

The uſe of the collection to Phyſicians.

The principal caſes in which the Phyſician has need of theſe teſts are—1. *the examination of mineral waters.* 2. *the examination of wines or cyder which are ſuſpected to be adulterated.* 3. *the detection of the adminiſtration of poiſon, whether it be effected by corroſive ſublimate, arſenic, or by any other metallic ſolution.* 4. *the diſcovery of the genuineneſs of galenical or chemical preparations, at viſitations of apothecaries ſhops.*

Examination of mineral waters.

As the phyſician muſt neceſſarily be acquainted, from chemiſtry, with all the circumſtances neceſſary to be practiſed in inveſtigations of this kind, I need not dwell long upon this ſubject. The following are the principal ſubſtances that have in theſe latter times been found to exiſt in mineral waters:—1. *Uncombined fixed air.* 2. *Hepatic air.* 3. *Chalk, or calcareous earth united with fixed air.* 4. *Magneſia united with fixed air.* 5. *Iron combined with*

with fixed air. 6. *Mineral alkali united with fixed air.* 7. *Glauber's ſalt.* 8. *Vitriolated tartar.* 9. *Gypſum.* 10. *Epſom ſalt.* 11. *Alum.* 12. *Martial vitriol.* 13. *Priſmatic nitre.* 14. *Nitre with a calcareous baſis.* 15. *Nitre with baſis of magneſia.* 16. *Common ſalt.* 17. *Common ſalt with a calcareous baſis.* 18. *Common ſalt with baſis of magneſia.* 19. *Sulphur.* 20. *Liver of ſulphur.* 21. *Extractive matter.*

Now accordingly as one of theſe ſubſtances remarkably predominates in mineral waters, or is contained in a greater quantity than others in them, theſe waters are farther divided into— 1. *Bitter purging waters.* 2. *Alkaline waters.* 3. *Muriatic waters.* 4. *Chalybeate waters.* 5. *Sulphureous waters.* 6. *Nitrous waters.*

In the examination of mineral waters therefore the phyſician ought to pay particular attention to the conſtituent parts here indicated; but for the manner in which theſe conſtituent parts are to be diſcovered by the re-agents, I muſt refer the reader to the above-mentioned experiments. Thus we ſhall diſcover—

1. *Fixed air*, by Exp. 2. 5. 21. 27. 31. 32. 78.

2. *Hepatic air*, by Exp. 29. 86 94. 107. 114. 117. 120. 133.
3. *Calcareous earth united with fixed air*, by Exp. 8. 14. 22. 31. 32. 50. 79.
4. *Magnesia united with fixed air*, by Exp. 8. 14. 22. 56. 79.
5. *Iron combined with fixed air*, by Exp. 41. 47.
6. *Mineral alkali united with fixed air*, by Exp. 10. 13. 18. 98. 105. 122. 124. 126.
7. *Glauber's salt*, by Exp. 84. 88. 90. 97. 110. 149.
8. *Vitriolated tartar*, by Exp. 84. 88. 90. 97. 110. 149.
9. *Gypsum*, by Exp. 15. 51. 59. 63. 68. 74. 80. 84. 90. 97. 110. 129.
10. *Epsom salt*, by Exp. 34. 57. 66. 70. 75 80. 84. 90. 97. 110. 128. 149.
11. *Alum*, by Exp. 34. 58. 64. 70, 80. 84. 90. 97. 110. 130.
12. *Martial vitriol*, by Exp. 42. 48. 61. 71. 81. 84. 101. 102. 140. 145.
13. *Prismatic nitre*, by Exp. 25. 149.
14. *Nitre with a calcareous basis*, by Exp. 23. 25. 51. 59. 63. 66. 68. 74. 80. 129.

15. *Nitre*

15. *Nitre with baſis of magneſia*, by Exp. 25. 34. 57. 66. 75. 80. 128.

16. *Common ſalt*, by Exp. 25. 89. 90. 96. 111.

17. *Common ſalt with a calcareous baſis*, by Exp. 23. 25. 51. 57. 66. 70. 75. 80. 90. 96. 111. 128. 149.

18. *Common ſalt with baſis of magneſia*, by Exp. 25. 34. 57. 66. 75. 80. 90. 96. 111. 128.

19. *Sulphur*, by Exp. 119. 120.

20. *Liver of ſulphur*, by Exp. 28. 85. 93. 99. 106. 113. 116. 119. 132.

28. *Extractive matter*. T.

Now, when it is diſcovered by the re-agents, which are the conſtituent parts that are principally to be attended to, we muſt endeavour to determine the quantity of theſe conſtituent parts, as exactly as poſſible, in the dry way: but, as it is beſide my plan to treat in this place of the examination of bodies in the dry way, I beg leave to refer the reader to the following authors:

T. Bergman de Analyſi Aquarum in Opuſc. Phyſ. et Chem. vol. i. p. 68.

Strachling, Methodus Generalis explorandi Aquas Medicatas. Poſon et Lipſiæ, 1775.

Weſtrumb, Inſtructions with reſpect to the

Examination of Mineral Waters, in his Phyſico-chemical Eſſays, vol. i. part 2, p. 71.

Examination of Wines of a ſuſpected Quality.

Of all poſſible modes of adulterating wines, that is the moſt hurtful to the conſtitution which is effected by *lead*; in examining wine of a ſuſpected quality, therefore, particular attention ought to be paid to this mode of adulteration. Lead is known to produce, with vegetable acids, a ſalt ſimilar in its taſte to ſugar (*viz.* ſugar of lead); but this agreeable taſte may alſo be imparted to acid wines, which, by this means, will be rendered palatable. Now in order to diſcover this highly reprehenſible adulteration, the *Wurtenburg wine-teſt* * (as it is called) has for many years paſt been generally uſed; till at length it was found that a common ſolution of liver of ſulphur will have the ſame effect. It is ſufficiently well known in chemiſtry, that from the liver of ſulphur, and conſequently alſo from the Wurtenburg wine-teſt,

* This is uſually made of two parts of orpiment, four of quicklime, and twelve of water, by boiling them up together, and then filtering off the liquor.

the

the diſſolved ſulphur is precipitated, by any pure acid, of a *white* (Exp. 28. 137.) or *pale yellow* colour; but if the acids contain heterogeneous particles, and particularly metals, the precipitated ſulphur appears of a more or leſs *dark* hue. (Exp. 85. 93. 99. 106. 113. 140. 141.) Now every kind of wine, by means of the uncombined portion of vegetable acid it contains, effects the very ſame precipitation; and if, on the examination of any kind of wine, the precipitate chanced to turn out of a rather darkiſh caſt by this wine-teſt, the merchant from whom the wine was bought was immediately conſidered as criminal. I could here adduce ſeveral melancholy inſtances, in which, even in theſe later times, vintners of the greateſt probity, merely in conſequence of a faulty examination of a parcel of wine with the Wurtenburg wine-teſt, have loſt both their character and fortune; and in which, after a more accurate inveſtigation, the merchant's innocence was proved. It may be perfectly right to ſuſpect wine, which exhibits a dark precipitate with this wine-teſt, of containing metallic particles; but it does not abſolutely follow that it contains a metal prejudicial to health. The wine may

take up particles of iron (which however are more conducive than hurtful to health), either in the firſt preparation of it, in the preſſing for inſtance, in which inſtruments are always uſed that have iron in their compoſition; or it may take theſe particles from the nails which may chance to be about the caſk in which it is kept; and in this caſe it will in like manner exhibit with the wine-teſt, or with any other liver of ſulphur, a dark-coloured precipitate (Exp. 140). I have alſo known, and that not from others, but from my own reiterated experience, wines of different colours to produce precipitates of a colour totally different from their own; although at the ſame time I was perfectly convinced that they contained neither lead nor iron, and that therefore the colour proceeded merely from a greater or leſs quantity of oily particles naturally contained in all wines, eſpecially when they are old. Hence it is certain that every liquid which is to be uſed as a wine-teſt, is defective, if it yields a precipitate with neat wines.

In the great progreſs which chemiſtry has made of late years, it could not fail of finding out a leſs fallible remedy, poſſeſſing all the qualities neceſſary for this purpoſe; *viz.* 1. That

of

of not producing any precipitate with genuine wine: 2. Of not precipitating iron contained in the wine: 3. Of indicating the preſence of lead, or of any other metal prejudicial to health, by a more or leſs dark-coloured precipitate. This means is now diſcovered; and is that which occurs in the Collection under the name of *hepatic-water*, or Dr. *Hahnemann's Wine-teſt*; the compoſition of which, conſiſting of calcareous liver of ſulphur, cream of tartar, and water, is deſcribed at No. II. in the Introduction, and of which the effect is known from Exp. 142. 143. 145. 146.

Now the examination of a parcel of wine of a ſuſpected quality is performed in the following manner:—To two or three ounces of wine add a ſpoonful of this wine-teſt newly prepared: if the wine is entirely without any noxious metal, it will remain tranſparent, and not become turbid in the leaſt; but if it contains *lead*, or any other *metal* of a *deleterious nature*, more or leſs of a dark precipitate will appear, according as more or leſs of theſe metallic particles are preſent. If there be any iron in the wine, it may be diſcovered—

1. By

1. By the addition of a few drops of tincture of galls (Exp. 48).

2. By the hepatic water. No. I.

3. If to the wine that has been mixed with *Hahnemann's wine-teſt* No. II. a few drops are added of the ſolution of the fixed vegetable alkali O, by which means the redundant acid, that holds the iron in ſolution, is taken away, this wine-teſt becomes ſimilar to that of No. I. and the iron will then diſcover itſelf by a *black precipitate* (Exp. 145), which will diſappear again on the addition of a few drops of vitriolic acid.

Now, in order to render this teſt ſtill more convincing, diſſolve in four ounces of any neat wine a few grains of ſugar of lead, and in four ounces more of the ſame wine a few grains of martial vitriol, and filter off both the ſolutions very nicely. Now if the above experiments are repeated with theſe wines, all that has been advanced before, will be found to be perfectly confirmed; and theſe experiments may be conſidered equally as trials of a wine that has been accidentally impregnated with iron, and of one that has been intentionally adulterated with lead.

In

In order alſo to be convinced of the uſual Wurtenburg wine-teſt being really defective, prepare it according to the preſcription given above, and compare its effects with thoſe of *Hahnemann*'s.

If Dr. *Hahnemann*'s wine-teſt indicates the preſence of a very ſmall portion only of lead, and ſtill the quantity of it is to be determined in a ſummary way, a certain quantity of the wine is to be boiled down to the fourth or eighth part; and if it be rendered turbid by theſe means, it muſt be filtered. To the wine thus filtered, vitriolic acid is to be added, till no more white precipitate is formed. This precipitate, which is vitriol of lead (Exp. 110), is to be ſeparated, and, when it is become dry, accurately weighed. Now, according to *Bergman*, 143 grains of this precipitate contain 100 grains of lead; but, beſides this, muſt be taken into the account, for every 20 ounces of the liquid, one grain more of vitriol of lead, that remains diſſolved in it.

Vid. *Hahnemann on the Wine-teſt for Iron and Lead in Crell's Chemical Annals* 1778, *vol.* i. *p.* 291.

Poiſons.

Corroſive ſublimate and arſenic being the ſtrongeſt of all the known mineral poiſons, and

of

of which a very ſmall quantity is ſufficient to occaſion death; the detection of ſuch poiſons is one of the moſt important objects of attention to the phyſician. If the poiſoned perſon has taken *corroſive ſublimate*, the preſence of this ſalt may be demonſtrated by Exp. 35. 104. 105. 106. 107. Whether the blame is to be laid on *arſenic* or not, may be learned from Exp. 37. 116. 117. 131. 135. 138. 144. But, as people may be poiſoned alſo by means of other metals, when diſſolved in acids, *viz.* by *lead*, *copper*, *regulus of antimony*, &c. in order to diſcover this, the experiments 38. 39. 72. 76. 139. 141. 146. 147. 148. are to be made.

As a great deal depends upon inveſtigations of this kind, which muſt be made conſcientiouſly, and the ſuppoſed poiſon alſo muſt be frequently collected into one maſs by very tedious operations; it would certainly be neceſſary to lay down here ample and circumſtantial inſtructions for this purpoſe. But as Dr. Hahnemann, in the above-mentioned book, p. 26, has made known every precaution that it is poſſible to take, and I ſhould be under the neceſſity of merely giving extracts of them here, I beg leave to refer the reader to the book itſelf.

TO DISCOVER THE GENUINENESS OF CHEMICAL AND GALENICAL PREPARATIONS, AT THE VISITATIONS OF APOTHECARIES SHOPS.

Examination of ſaline preparations.

Vitriolic Acid.

(Acidum Vitrioli.)

The *Vitriolic acid*, kept in the ſhops under the name of *Oil of Vitriol* or *Spirit of Vitriol*, may carry over with it in the diſtillation a ſmall quantity of *copper* or *iron*, or it may be accidentally impregnated with either of theſe metals by a careleſs and ſlovenly management of the proceſs: and the Engliſh oil of vitriol, prepared from ſulphur, is ſaid frequently to hold *lead* in ſolution; this latter has alſo frequently been found to have a little vegetable alkali combined with it. Now, in order to diſcover this admixture, a little of the vitriolic acid, that is ſuſpected to be impure, is to be diluted with diſtilled water, and ſaturated with the *mild vegetable alkali* O, by which means the copper, iron, and lead will be thrown down in the form of a more or leſs dark-coloured precipitate.

This

This precipitate is to be thoroughly edulcorated with diſtilled water, and dried. If then the cauſtic volatile alkali P be poured upon it, the *blue colour* which the alkali receives from it, will ſhew that copper is preſent (Exp. 72). The blue liquid is to be waſhed off again from the precipitate with diſtilled water, and the remainder diſſolved in pure marine acid. Now if on adding to the ſolution a little of the wine-teſt No. II. a *blackiſh brown precipitate* appears, it is a ſign that it contained lead; and any iron that may happen to be preſent, will be found in the liquid that remains after the ſeparation of this dark precipitate. Vegetable alkali, contained in this acid, is not eaſily to be diſcovered by the re-agents. The vitriolic acid may be ſaturated with the volatile alkali P. or Q., and to this ſolution may be added a few drops of acid of tartar diſſolved in diſtilled water; when the latter will unite with the vegetable alkali that is preſent, and be depoſited in the form of *cream of tartar*. If the quantity contained in the acid be not very ſmall indeed, it may alſo be diſcovered, by mixing the vitriolic acid with equal parts of ſpirit of wine. By this means

the

the mixture will become turbid, and a quantity of *vitriolated tartar* be ſeparated from it in the form of ſlender ſharp-pointed cryſtals (Exp. 149).

Nitrous acid.

Nitrous acid may be rendered impure by the admixture of *vitriolic* or *marine* acid. The vitriolic acid may be diſcovered in it, by adding to it a few drops of the ſolution either of ponderous earth, or of ſugar of lead S. Z. and the *marine acid* by the ſolution of ſilver T. In the firſt caſe, ponderous ſpar or vitriol of lead, and in the latter luna cornea, is generated (Exp. 83. 89. 110).

Marine acid.

(Acidum Salis.)

Marine acid may contain *vitriolic acid*, *copper* and *iron*. The *vitriolic acid* is diſcovered by the ſolution either of ponderous earth or of ſugar of lead (Exp. 83. 110). The preſence of *copper* is detected by ſuperſaturating the acid with deaërated or cauſtic volatile alkali P. (Exp. 72.) The preſence of *iron* is manifeſted by ſaturating the acid with the fixed alkaline ſalt O. and then adding to it tincture of galls (Exp. 48).

Vine-

Vinegar.
(Acetum.)

Vinegar may be mixed with the *vitriolic*, *marine*, and *tartareous acids*. The *firſt* of theſe admixtures is diſcovered by the ſolution either of ponderous earth or of ſugar of lead S Z. (Exp. 83. 110.) the *marine acid* by the ſolution of ſilver T. (Exp. 89.) and the *tartareous acid* by ſaturating the vinegar with the *vegetable alkali* O, in conſequence of which cream of tartar will be ſeparated in the form of a white powder. If there ſhould chance to be any *copper* in the vinegar, it may be diſcovered by ſaturating it with the volatile alkali P. Q. (Exp. 76).

Diſtilled vinegar.
(Acetum diſtillatum.)

Vinegar is frequently diſtilled, not in glaſs veſſels, but in a ſtill with a pewter head; in which caſe it is liable to take up particles of lead from the diſtilling veſſel, the pewter being ſeldom free from *lead*. This circumſtance may be diſcovered by the wine-teſt H. H. which will produce a precipitate of a *blackiſh brown* colour (Exp. 114. 146).

Eſſential

Eſſential Acid of Tartar.

(Acidum Tartari eſſentiale.)

Eſſential Acid of Tartar may very eaſily be contaminated with *vitriolic acid*, either intentionally, or in conſequence of a faulty preparation. This admixture of vitriolic acid is ſoon diſcovered, if a ſmall quantity of the acid of tartar be diſſolved in diſtilled water, and a few drops of the ſolution of lead Z. added to it; by this means a white precipitate is produced, which, by the addition of a few drops of the pure nitrous acid G. will be entirely rediſſolved, if no vitriolic acid is contained in it. The preſence of vitriolic acid is ſtill more readily manifeſted, by adding to the acid of tartar diſſolved in diſtilled water, a few drops of the ſolution of ponderous earth S. in conſequence of which ponderous ſpar is immediately generated. (Exp. 83.)

Salt of Amber.

(Sal Succini.)

On account of the high price which Salt of Amber bears, it is often purpoſely adulterated with *vitriolic acid* and *its compounds*, with *acid of tartar*, and perhaps now and then with *ſal ammoniac*. The *vitriolic acid* is diſcovered by means

of the ſolution of ponderous earth, or of ſugar of lead S. Z. (Exp. 83. 84. 110.) by letting fall a few drops of either into the ſolution of ſalt of amber in diſtilled water. The *acid of tartar* is diſcovered by the vegetable fixed alkali O. by adding a few drops of this ſalt to the ſolution of it; for if this be preſent, a quantity of cream of tartar will fall to the bottom. The preſence of ſal ammoniac is diſcovered, with reſpect to one of its component parts, the marine acid, by the ſolution of ſilver T. (Exp. 90.); and with reſpect to the other, the volatile alkali, by adding to the ſolution of this ſalt in diſtilled water, a few drops of the fixed alkali N. or O. and, after heating the mixture, holding over it a ſtopper moiſtened with acetous acid. (Exp. 54.)

Sedative Salt.

(Sal ſedativum Hombergii.)

Genuine *Sedative Salt* is ſoluble in five times its quantity of boiling hot ſpirit of wine, and the ſolution, when ſet fire to, burns with a *green flame*. Submitted to the blow-pipe it fluxes to a tranſparent glaſs, ſoluble in water, and vitrifies earths and ſtones. If it be added in ſmall quantities to cream of tartar, it transforms this

ſubſtance

ſubſtance into a very ſoluble ſalt, known by the name of *Boracic Tartar.*

Salt of Tartar.

(Sal Tartari.)

Inſtead of pure *Salt of Tartar*, we frequently meet with mere purified pearl-aſhes, which however are ſeldom free from heterogeneous particles. This ſalt has often *ſiliceous earth* mixed with it, and perhaps other heterogeneous ſalts, compoſed of *vitriolic* and *marine acid.* In order to diſcover the preſence of *ſiliceous earth*, a little of the ſalt is diſſolved in diſtilled water, and ſaturated with any of the pure acids in the collection, by which means the ſiliceous earth is precipitated; by the ſame proceſs other earths alſo, which may chance to be mixed with it, are ſeparated. *Vitriolic acid* is diſcovered by diſſolving the alkali in diſtilled water, ſaturating it with pure nitrous or acetous acid, and then adding to it a few drops of the ſolution of ponderous earth or of ſugar of lead S. Z. when a precipitate will be produced. (Exp. 83. 84. 85. 110.) The preſence of *marine acid* is manifeſted, by adding to this ſalt ſaturated with nitrous acid, a few drops of the ſolution of ſilver

T. (Exp. 89. 90.) in conſequence of which luna cornea is generated.

Mineral Alkali.

(Alkali minerale.)

Barillas contain for the moſt part, beſides mineral alkali, other *heterogeneous ſalts*, which remain mixed with the mineral alkali obtained from it by elixation; in like manner alſo it is difficult to ſeparate this alkali from Glauber's or common ſalt in ſo pure a ſtate that it ſhall not retain a little *vitriolated tartar* or *common ſalt*. If it is purchaſed in the form of powder, it may likewiſe be adulterated purpoſely with *Glauber's ſalt* or *ſalt of tartar*. In order to diſcover the vitriolic and marine ſalts that are ſometimes mixed with it, proceed in the ſame manner as with the *ſalt of tartar*; and the vegetable alkali is diſcovered in it, by adding to a ſolution of mineral alkali a few drops of the acid of tartar, by which means *cream of tartar* will fall to the bottom of the veſſel.

Cauſtic Spirit of Sal Ammoniac.

(Spiritus Salis Ammoniaci cum Calce viva.)

In order to diſcover, whether the *Cauſtic Spirit*

rit of Sal Ammoniac be entirely free from fixed air, mix with it a ſmall quantity of a ſolution of pure calcareous earth in the marine acid, which may be eaſily prepared from a little quick-lime and the marine acid contained in the collection; if the ſpirit be entirely free from fixed air, *no precipitate* will appear, when a little of this ſolution of calcareous earth is mixed with diſtilled water, and a few drops of the cauſtic ſpirit that is to be examined are added to it. But if mild or aerated calcareous earth falls to the bottom, (Exp. 74.) the volatile ſpirit was not entirely free from fixed air. If *mineral chamæleon* is at hand, it may ſerve for a teſt juſt as well as this; for the ſpirit, if there be any fixed air in it, will be tinged *red* by this preparation; but if it be perfectly cauſtic, it will remain *green.*

Concrete volatile Alkali.

(Alkali volatile.)

This ſalt ſhould be *totally volatile;* for if any one ſhould attempt to put off a mixture of ſal ammoniac and ſalt of tartar for it, the heating a little of it upon an iron inſtrument would ſoon ſhew this adulteration, as digeſtive

ſalt would remain behind. This alkali, when diſſolved in no greater quantity of diſtilled water than it requires for its ſolution, if the ſolution be mixed with ſpirit of wine, will concrete into a *cryſtalline maſs*, becauſe the volatile alkali is ſeparated by the ſpirit of wine. (Exp. 149.)

Salt of Hartſhorn.

(Sal Cornu Cervi volatile.)

The genuineneſs of *Salt of Hartſhorn* may be diſcovered in the ſame manner as that of volatile alkali; as it differs from the latter merely in being impregnated with a ſmall quantity of animal-oily particles.

Spirit of Hartſhorn.

(Spiritus Cornu Cervi.)

Fraudulent chemiſts are accuſtomed to cohobate their *Spirit of Hartſhorn* upon quicklime, in order to make it the ſtronger, and thus to give to a weak ſpirit the appearance of one well ſaturated with volatile alkali. This fraud may be diſcovered, by adding ſpirit of wine to the ſpirit of Hartſhorn; for if *no cryſtallized volatile alkali* appears in conſequence of this addition, (Exp. 149.) the adulteration above indicated may

may be ſuſpected; it may even be diſcovered by the circumſtance of the ſpirit not efferveſcing briſkly with acids.

Glauber's Salt.

Glauber's Salt ought to contain neither *redundant acid* nor *alkali*, neither ſhould it be mixed with earthly ſalts: the firſt of theſe defects is diſcovered by means of the tincture of litmus, and the different coloured papers, (Exp. 3. 6. 10. 13. 18.) by examining the ſolution of this ſalt with them in diſtilled water. The preſence of the earthy ſalts in this ſalt is diſcovered, by adding to the ſolution of it a few drops of the pure mild *vegetable alkali* O. (Exp. 63. 64. 65. 66.) and the preſence of marine acid will be manifeſted by Exp. 25. 89. 90.

Vitriolated Tartar.

(Tartarus vitriolatus.)

The impurities in *Vitriolated Tartar* may be the ſame as thoſe in Glauber's ſalt, and may be diſcovered by the ſame means. Very frequently the caput mortuum, which remains after the diſtillation of aqua fortis by means of vitriol, is, after elixation and cryſtallization, made

uſe of for this ſalt. But as chemiſts for the moſt part are not ſufficiently careful with reſpect to the addition of vitriol, nor indeed know how to purify this ſalt in a proper manner; it frequently happens, that a little undecompoſed vitriol remains mixed with this ſalt, and for that reaſon contains not only *vitriol of iron*, but perhaps alſo of *copper*. In order to diſcover this, diſſolve a little of this ſalt in diſtilled water, and add a few drops of the vegetable fixed alkali O. to it; if a precipitate appears, the ſalt is not pure. The precipitate being collected, and rediſſolved in marine acid, it may be eaſily found whether *iron* and *copper* are preſent or not, by Exp. 48. and 72.

Nitre.

(Nitrum.)

To *Nitre*, from a fault in the purification of it, there frequently adhere particles of *marine ſalt*, or elſe it is purpoſely adulterated by fraudulent chemiſts with *Glauber's ſalt*. The latter circumſtance is immediately diſcoverable, by the *bitter* taſte that is intermixed with the genuine taſte of the ſalt, and by the *inferior* livelineſs of its detonation. Beſides this, any particles of

marine

marine ſalt that may adhere to it, may be detected by the ſolution of ſilver, T. (Exp. 89. and 90.) and the preſence of *Glauber's ſalt* by the ſolution of ponderous earth, and by that of lead, S. Z.

Sal Ammoniac.

(Sal Ammoniacum.)

Genuine Sal Ammoniac, when laid on a red-hot iron, ought to fly off entirely, and when it is perfectly free from *vitriolic acid*, and a little of it is diſſolved in diſtilled water, does *not* form a *precipitate*, on a few drops of the ſolution of ſilver or of that of lead, S. Z. (Exp. 83. 84. 110.) being added to it.

Diuretic Salt.

(Sal diureticus, *or* Terra foliata Tartari.)

Genuine Diuretic Salt is perfectly ſoluble in four times its weight of ſpirit of wine, and therefore ſuch heterogeneous ſalts as are mixed with it, and which are *inſoluble in ſpirit of wine*, may be diſcovered by theſe means, as they remain behind undiſſolved. A few drops of nitrous or marine acid added to a ſolution of this ſalt in diſtilled

diſtilled water, ought not to ſeparate cream of tartar from it, but the acetous acid muſt be diſengaged by this means; which latter circumſtance is perceived by the ſour ſmell of the vinegar that is making its eſcape. In caſe the diuretic ſalt has been prepared by precipitating ſugar of lead with fixed vegetable alkali, and, in conſequence of a bad management of the proceſs, ſome particles of lead have remained with it; this circumſtance may be diſcovered, by pouring to the ſolution of this ſalt a little hepatic water, II. (Exp. 46.) by which means a *precipitate* of a *dark brown colour* is formed, which is not capable of being rediſſolved by the addition of a few drops of vitriolic acid.

Rochelle Salt, or *Salt of Seignetti.*

(Sal Rupellenſe, *ſive* Polychreſtum Seignetti.)

The external cryſtalline form of *Rochelle* Salt ſufficiently ſhews when it is adulterated with *Glauber's ſalt*. But if a little of it is diſſolved in diſtilled water, and ſome of the ſolution of lead Z. is added to it, a *white precipitate* is formed, which is not rediſſolved, by the addition of a few drops of the nitrous acid G. If a few drops of any of the acids contained in the collection are

added

added to a ſolution of genuine Rochelle ſalt, a quantity of *cream of tartar* will be ſeparated from it.

Soluble Tartar.

(Tartarus ſolubilis, *or* Tartarus tartariſatus.)

Soluble Tartar does not cryſtallize ſo eaſily as Rochelle ſalt, but it is liable to be adulterated with the ſame ſalts as Rochelle ſalt, and for this reaſon the adulteration of it may be diſcovered in the ſame manner.

Epſom Salt.

(Sal catharticus amarus.)

Epſom Salt may contain *magneſia ſalita*, i. e. *magneſia ſaturated with marine acid*, as alſo *Glauber's ſalt*. If it contains the former, it readily becomes moiſt, and from the ſolution of it in diſtilled water, the ſolution of ſilver T. (Exp. 89. 90.) will precipitate luna cornea. If this ſalt falls to powder by expoſure to a dry air, it contains Glauber's ſalt. Mere Glauber's ſalt likewiſe is frequently ſubſtituted for it; when, in order to obtain ſuch ſmall cryſtals as thoſe of Epſom ſalt, the cryſtallization is interrupted by ſtirring the liquid at the inſtant that it is going

to

to cryſtallize. This latter fraud may be diſcovered, by diſſolving and cryſtallizing it afreſh: likewiſe if it is mere Glauber's ſalt, the ſolution of vegetable alkali O. will not ſeparate any magneſia from it.

Alum.

(Alumen.)

Perfectly pure *Alum* ought to conſiſt merely of earth of alum and vitriolic acid, and contain no *iron* nor *copper*. *Iron* is diſcovered by diſſolving a little of the alum in diſtilled water, and adding a few drops of the lixivium of Pruſſian blue F. or tincture of galls K. when, in the former caſe a *blue*, and in the latter a *black precipitate* will be formed. (Exp. 42. 48.) *Copper* may be detected by the cauſtic volatile alkali P. (Exp. 72.)

Borax.

(Borax.)

Borax, which ſhould conſiſt of mineral alkali and ſedative ſalt, is liable to be mixed with other ſalts that reſemble borax in their external form, E. G. with *alum* or *ſal gem.* The *alum* is diſcovered by diſſolving a little of the borax in diſtilled water, and pouring ſo much of the ma-

rine

rine acid to it, till the redundant alkaline part is perfectly ſaturated, and then adding to it a few drops of the ſolution of ponderous earth S. Now if there be any vitriolic acid in it, a real ponderous ſpar will, according to Exp. 83. and 84. fall to the bottom of the veſſel. The alkaline part that is redundant in the borax, muſt be previouſly ſaturated with marine acid; for this reaſon, that this acid may not be able to act upon the ſolution of ponderous earth, and produce a precipitate with it. If marine acid be preſent, it will be made manifeſt by Exp. 25. or it may be diſcovered by the ſolution of ſilver, T. (Exp. 92.) provided the redundant alkaline part be previouſly ſaturated with the pure nitrous acid G.

Mindererus's Spirit.

(Spiritus Mindereri.)

The genuineneſs of *Mindererus's Spirit* may be diſcovered in the ſame manner as that of ſal diureticus; and the preſence of the volatile alkali is manifeſted by the *volatile ſmell* that takes place, when a little of the ſolution of vegetable alkali O. is added to it, and the liquid is made warm; at the ſame time too its preſence will

will be demonſtrated by the *clouds* which appear, if a ſtopper moiſtened with acetous acid M. (Exp. 54.) is held over the ſurface of this liquid.

Succinated Salt of Hartſhorn.

(Liquor Cornu Cervi ſuccinatus.)

This *liquor* ſhould, in ſtrict propriety, be compoſed of ſalt of hartſhorn perfectly ſaturated with ſalt of amber. But this latter article being very dear, other acid ſalts are frequently combined with the ſalt of hartſhorn, and this mixture is ſubſtituted for ſuccinated ſalt of hartſhorn. Now if it contain either the *marine*, *nitrous* or *acetous acid*, the fraud may be diſcovered, by adding a few drops of vitriolic acid to the liquid, warming it, and holding over its ſurface a ſtopper moiſtened with volatile alkali, when the heterogeneous acid becomes viſible by the *clouds* that are formed on this occaſion. (Exp. 54.) The preſence of *marine acid* may alſo be diſcovered by the ſolution of ſilver T. purſuant to Exp. 89. 90.

Cream of Tartar.

(Cremor Tartari, Cryſtalli Tartari.)

Cream of Tartar, or Cryſtals of Tartar, being a

combination of vegetable alkali ſuperſaturated with acid of tartar, is known by the peculiar ſmell it yields, when placed upon burning coals. If cream of tartar be adulterated with any of the vitriolic ſalts, the ſolution of lead Z. added to a ſolution of the former, will form a *white precipitate*, which is not ſoluble again in the nitrous acid. Any *copper* it may chance to contain is diſcoverable by the volatile alkali, purſuant to Exp. 72.

White Vitriol.

(Vitriolum Zinci.)

When *White Vitriol* is to be uſed as a medicine, it muſt conſiſt entirely of zinc and vitriolic acid, and ſhould contain neither *iron* nor *copper*; though iron, it is true, would do no harm in it. *Copper* is diſcovered by means of volatile alkali, (Exp. 72. and 76.) by adding a little of it to a ſolution of white vitriol in diſtilled water. The preſence of *iron* is detected by the tincture of galls K. purſuant to Exp. 48.

Emetic Tartar.

(Tartarus emeticus.)

Emetic Tartar, a combination of calx of antimony

mony with cream of tartar, forms, it is true, when genuine, a white precipitate with the ſolution of lead Z. but is ſoluble again by the nitrous acid G. If a little emetic tartar be diſſolved in diſtilled water, and a few drops of the volatile liver of ſulphur G. G. or of the hepatic water H. H. be added to it, a ſulphur auratum antimonii, or mineral kermes, will fall to the bottom of the veſſel. (Exp. 139. 148.)

Butter of Antimony.

(Butyrum, *ſive* Oleum Antimonii.)

Butter or *Oil of Antimony* ſhould conſiſt of calx of antimony and marine acid; and, if it be genuine, the white calx of antimony, which is ſoluble in vegetable acids, will be precipitated from it by the addition of diſtilled water. The volatile liver of ſulphur G. G. and the hepatic water H. H. act upon it in the ſame manner as they do upon emetic tartar. (Exp. 139. 148).

Corroſive Sublimate.

(Mercurius ſublimatus corroſivus.)

Corroſive Sublimate, which ſhould conſiſt of Mercury ſuperſaturated with marine acid, is often ſuſpected to be adulterated with *arſenic*.

Though

Though this may probably ſeldom be the caſe, yet, when it is, the fraud may be diſcovered in the following manner: Diſſolve a ſmall quantity of the ſublimate in diſtilled water, precipitate the mercury out of it by the mild volatile alkali Q. and filter the liquid, in order to ſeparate the precipitate, which is white: now if, on the addition of a few drops of the cuprum ammoniacum F. F. to this filtered liquor, a tranſparent *blue* liquid is formed, the corroſive ſublimate is free from arſenic; but if a precipitate of a *yellowiſh green colour* is produced, (Exp. 135.) then it contains arſenic. How corroſive ſublimate is affected by lime-water and alkaline ſalts, may be ſeen in Exp. 35. 104. 105.

Calomel.

(Mercurius dulcis.)

In Calomel the marine acid muſt be completely ſaturated with mercury, and in this ſtate it is ſaid to be *perfectly dulcified.* This is known to be the caſe, when, upon a little of it being rubbed in a glaſs mortar with the cauſtic volatile alkali P. or with the lime-water H,

a *black* but *no orange colour* (Exp. 35. 104.) is produced.

Sugar of Lead.

(Saccharum Saturni.)

If *Sugar of Lead*, which ſhould conſiſt of vinegar ſaturated with lead, be adulterated with nitre of lead, the fraud will be diſcovered by the ſmell of aqua fortis, that will ariſe, on adding to a ſolution of it in diſtilled water, a few drops of the vitriolic acid F. (Exp. 25.) and warming the mixture.

Vitriol of Copper, or *Blue Vitriol.*

(Vitriolum cœruleum.)

Vitriol of Copper ſhould conſiſt entirely of copper and vitriolic acid; but *iron* and *zinc* may alſo chance to be combined with it. In order to diſcover this, diſſolve a little of it in diſtilled water, and add to it a few drops of the cauſtic volatile alkali P. The liquid, it is true, will become ſomewhat turbid at firſt; but by pouring more of the alkaline ſolution to it, the whole will be rediſſolved, and form a tranſparent mixture of a *blue* colour, provided the vitriol be per-

fectly pure. But if there be iron in the mixture, a *black calx* will be precipitated, which will *become yellow on being expoſed to the air*; but if the precipitate be *white*, it is a ſign that the vitriol contains *zinc*.

Vitriol of Iron, or *Martial Green Vitriol*.

(Vitriolum Martis.)

Vitriol of Iron, when it is to be uſed as a medicine, ſhould conſiſt entirely of iron and vitriolic acid, and particularly it ſhould not contain any *copper*. The preſence of this latter metal is diſcovered, by putting into a ſolution of this vitriol a piece of poliſhed iron, which by this means will be covered with *a coat of copper*.

Lunar Cauſtic.

(Cauſticum lunare.)

Lunar Cauſtic muſt be prepared of perfectly pure ſilver, and nitrous acid; but if the ſilver, which has been made uſe of for this purpoſe, is not free from copper, the lunar cauſtic will eaſily *attract the moiſture of the air*, and is *not ſo cauſtic* as it ſhould be. The preſence of *copper* is diſcovered by the volatile alkali P. Q. (Exp

72. 76.) by pouring it upon a little of the lunar cauſtic.

Inveſtigation of Earthy Preparations.

Magneſia.

(Magneſia alba.)

Magneſia ſhould be perfectly free from any admixture with the other abſorbent earths. It is frequently found adulterated with *calcareous earth;* and this circumſtance is very eaſily diſcovered by the vitriolic acid F. for in this caſe, out of the acid and the calcareous earth a ſelenite will be formed, (Exp. 23.) which, on the ſolution of the magneſia by the acid, will remain in the form of a white powder behind. But if a perfectly clear ſolution is produced by the vitriolic acid, and after ſome time no ſelenite falls to the bottom of the veſſel, then it is entirely free from calcareous earth. This latter earth alſo may be diſcovered, when preſent in magneſia, by diſſolving the magneſia in a rather redundant quantity of nitrous or marine acid, and diluting this ſolution with 300 parts of diſtilled water, and then adding mineral alkali to it, till no more white precipitate is produced;

duced: crude calcareous earth, or chalk, will be here precipitated, and the magnesia remain dissolved in the liquor.

Calcined Magnesia.

(Magnesia calcinata.)

Calcined Magnesia should *not effervesce with acids*, nor have *a caustic taste like quicklime;* and when concentrated vitriolic acid is poured upon it, it ought to acquire a *red heat.*

Investigation of Metals, and Metallic Preparations.

Flowers of Zinc.

(Flores Zinci.)

Flowers of Zinc, which are a pure calx of zinc, are liable to be adulterated with whiting: this fraud is discovered by pouring upon them a little of the nitrous acid G. diluted with distilled water, when the calcareous earth will be dissolved with effervescence: now if to this liquid a few drops of vitriolic acid are added, and evaporated by degrees, a true selenite will fall to the bottom of the vessel. (Exp. 23.)

Mercury, or *Quickſilver*.

(Mercurius vivus.)

Mercury ſhould be entirely volatile in the fire, and conſequently leave nothing behind it after evaporation; but this latter circumſtance will not take place, if it be adulterated with *lead*, *tin*, or *biſmuth*. The *lead* which may chance to be contained in it, is diſcovered by the *ſweetiſh taſte* which the acetous acid M. previouſly diluted a little, acquires, when ſhaken up with the mercury, or ſuffered to ſtand upon it for ſome time; but, beſides this, the preſence of lead may be diſcovered, by adding to this acetous acid, that has ſtood on the mercury, a few drops of the vitriolic acid F. in which caſe a *vitriol of lead* will be generated, (Exp. 110.) or by the volatile liver of ſulphur G. G. or elſe by the hepatic water H. H. (Exp. 113. 114. 146.) The tin which may chance to be contained in it, is converted into a *white calx* of tin, by pouring the nitrous acid G. upon the quickſilver, and conſequently its preſence may be diſcovered by this means. If biſmuth be contained in it, by adding to a ſolution of this mercury in the pure nitrous acid G. a quantity of diſtilled water, a *white precipitate* (magiſterium

rium marcaſitæ, or Spaniſh white) will be produced.

Cinnabar.

(Cinnabaris factitia.)

Cinnabar, a combination of ſulphur and mercury, may be adulterated with *red lead*; and the fraud is diſcovered in the ſame manner as it was in the inſtance of the mercury, by digeſting the cinnabar for ſome time with a little of the diluted acetous acid M. and examining it purſuant to the Experiments 113. 114. 146.

Red Precipitate.

(Mercurius precipitatus ruber.)

Genuine *Red Precipitate* is ſoluble in the nitrous acid G. with generation of heat, but without efferveſcence; the vitriolic acid F. forms with it Turpeth mineral, and the marine acid corroſive ſublimate, or, when it is perfectly ſaturated with marine acid, calomel. If it be adulterated with *red lead*, the fraud may be diſcovered in the ſame manner as in cinnabar, by pouring diluted acetous acid M. upon it, and examining this liquid purſuant to Exp. 113. 114. 146.

White Precipitate.

(Mercurius precipitatus albus.)

White Precipitate may be adulterated with *white lead*, or with *whiting*. The preſence of *white lead* may be diſcovered by the ſweetiſh taſte, that ariſes in conſequence of digeſting the precipitate in the acetous acid M. and alſo by the Experiments 113. 114. 146. If it contain aërated calcareous earth or *chalk*, an effervescence will enſue, on acetous acid being poured upon it, and the calcareous earth will be diſſolved in this acid: if a few drops of the vitriolic acid F. are added to it, and the liquid is gradually evaporated, ſelenite will be formed. (Exp. 23.)

White Lead.

(Ceruſſa.)

White Lead, or lead corroded by the vapours of acetous acid, may be adulterated either with *chalk*, or *ponderous ſpar*. If upon a ſmall quantity of it the nitrous acid G. be poured, the mere calx of lead will diſſolve in it, and the ponderous ſpar, that is preſent in the maſs, remain behind. But if it contain *chalk*, then add to the ſolution the vitriolic acid F. till no more

more white precipitate, or vitriol of lead, (Exp. 110.) is formed; when the calcareous earth, that was preſent in the mixture, will remain diſſolved in the nitrous acid, and may then be ſeparated by the mild fixed alkali O.

Red Lead.

(Minium.)

Minium, a red calx of lead, may be adulterated with *bole Armoniac*, *brick-duſt*, or the *caput mortuum of vitriol*. This adulteration may be detected, by pouring a little diluted acetous acid upon the red lead, and letting the mixture ſtand in a warm place. The calx of lead will be diſſolved, and the ſubſtances, with which the red lead was adulterated, will remain behind undiſſolved.

Tin.

(Stannum.)

Tin, that is to be uſed as a medicine, ought to be entirely free from *lead*. In order to diſcover the preſence of the latter, the pure nitrous acid G. is to be poured upon the tin, and the mixture ſet by in a warm place: the pure

tin

tin will be corroded by it into a white calx, and the lead, that is preſent in the maſs, will remain diſſolved in the acid. Whether any lead is contained in the remaining liquid, may be eaſily known by the Exp. 113. 114. 146. If, beſides, the tin is ſuſpected to contain *arſenic*, the lead, that was diſſolved in the nitrous acid, is to be precipitated with the alkaline ſalt O. and to the liquid, which is filtered off from it, a few drops of the cuprum ammoniacum F. F. are to be added; when, if arſenic be preſent, a *yellowiſh green precipitate* (Scheele's green, Exp. 135.) will be formed.

Verdigriſe.

(Viride Æris.)

Common Verdigriſe is liable to be adulterated with calcareous earth. In order to diſcover this fraud, diſſolve a little of the verdigriſe in the diluted vitriolic acid F. when the calx of copper only will be diſſolved, and the calcareous earth will remain behind in the form of ſelenite (Exp. 23.); but if *gypſum* be contained in the maſs, the pure calx of copper will be diſſolved in the diluted vitriolic acid F. when poured

poured upon it, and the *gypſum* will remain behind undiſſolved.

Iron.

(Ferrum.)

Iron, that is to be uſed as a medicine, muſt be entirely free from *copper*. The preſence of *copper* is diſcovered by the blue colour which the cauſtic volatile alkali P. acquires (Exp. 72.) when it is digeſted with the iron. A ſmall quantity of iron filings alſo may be diſſolved in marine acid, and a poliſhed iron put into this ſolution, when the iron will be *covered with a coat of copper*, if there be any of this latter metal among the iron filings.

Kermes mineral.

(Kermes minerale.)

Genuine *mineral Kermes* is perfectly ſoluble in cauſtic vegetable alkali. Put a few grains of it into a ſmall phial; pour a little of the cauſtic alkali N. upon it, and heat the mixture; the kermes mineral will be perfectly diſſolved in the alkali; but, as ſoon as the mixture is cold,

cold, will be depoſited again at the bottom of the phial.

Golden Sulphur of Antimony.

(Sulphur auratum Antimonii.)

The golden Sulphur of Antimony alſo ought to be perfectly ſoluble in the cauſtic vegetable alkali N. and the ſubſtances, with which it is adulterated, eſpecially when they are of an earthy nature, ſhould remain undiſſolved behind. But the kermes mineral *differs* from the ſulphur auratum *in this reſpect*, that it does not ſeparate from the alkali after the ſolution is grown cold, but remains diſſolved in it.

Preparations of Inflammable Subſtances.

The animal Oil of Dippelius.

(Oleum animale Dippelii.)

Dippelius's animal Oil, if it be genuine, and not adulterated with other oils, concretes with the ſolution of mercury U. ſo as to form a *yellow maſs*, which ſhortly after becomes black.

Dulcified Acid of Vitriol.

(Spiritus Vitrioli dulcis.)

Perfectly dulcified Spirit of Vitriol ought *not* to have

have *the leaſt ſulphureous* odour, nor a *perceptibly ſour taſte*, and therefore ſhould *not* impart a *red* colour to the tincture of litmus A. (Exp. 3.)

Dulcified Spirit of Nitre.

(Spiritus Nitri dulcis.)

The perfect dulcification of *Spirit of Nitre* is known by this teſt, that this ſpirit does not make the tincture of litmus A. red. The tincture of guaiacum, which may be eaſily prepared of genuine gum guaiacum and the ſpirit of wine I. I. ought *not* to produce a *blue colour* with it.

Vitriolic Æther.

(Naphta Vitrioli.)

Æther ought *not* to contain *any uncombined vitriolic acid*, nor have the leaſt *ſulphureous ſmell. The uncombined vitriolic acid* may be diſcovered by the ſolution of ponderous earth S. (Exp. 83.) and by the ſolution of ſugar of lead Z. (Exp. 90.)

Nitrous Æther.

(Naphta Nitri.)

Nitrous Æther in like manner ought not to contain

contain any uncombined acid, and for this reaſon ſhould *not* tinge the tincture of litmus A. *red, nor* the tincture of guaiacum *blue.*

Eſſential Oils.

(Olea ætherea.)

The finer kinds of æthereal oils are uſually adulterated, 1. with an *inferior æthereal oil,* viz. *oil of turpentine*; 2. with *an unguinous* or *expreſſed oil*; 3. with *ſpirit of wine.* The firſt of theſe different modes of adulteration may be perceived by the *ſmell of turpentine* yielded by the adulterated oil, when a few drops of it are poured upon a piece of linen cloth, and the cloth is ſwung to and fro in the air; in conſequence of which, the fine æthereal oil will fly off, and the oil of turpentine remain behind. The *ſecond mode of adulteration* is diſcovered, by letting a few drops of the oil fall upon paper, and expoſing this paper to heat, in conſequence of which the æthereal oil will evaporate, and the expreſſed oil remain behind, and form a *greaſy ſpot.* This mode of adulteration will alſo be detected, by a little of the ſpirit of wine I. I. being poured upon ſuch oil; the æthereal oil will be diſſolved in it, and the expreſſed oil remain

main undiſſolved behind. The *third mode of adulteration*, viz. that with ſpirit of wine, may be detected by the addition of water; if a little diſtilled water be mixed with an oil of this kind, the water will unite with the ſpirit of wine, and the quantity of æthereal oil contained in the mixture, will then be ſeparated. (Exp. 152.)

Reſin of Jalap.

(Reſina Jalappæ.)

Reſin of Jalap, on account of its high price, is frequently adulterated, by greedy chemiſts, with much cheaper reſins, viz. colophony, or common reſin, &c. or they will ſometimes even mix up ſome *powder of jalap* along with it. The firſt mode of adulteration may be readily perceived, by its being more brittle than the genuine, and by the ſmell of turpentine diffuſed by it; but the latter can only be diſcovered by diſſolving the reſin in the ſpirit of wine I. I. when the powder, that is mixed up with it, will remain undiſſolved behind. (Exp. 151.)

Milk of Sulphur.

(Lac Sulphuris.)

Milk of Sulphur is nothing more than ſul-

phur

phur diſſolved in an alkaline ſalt, and precipitated by acids. It is ſometimes purpoſely adulterated with *earth of alum*, *calcareous earth*, or *magneſia*. Such adulteration is beſt diſcovered, by pouring upon the milk of ſulphur, a quantity of the cauſtic vegetable alkali N. juſt ſufficient to cover it, and ſetting the mixture by in a warm place to digeſt, when the ſulphur will be diſſolved, and the earths that are mixed with it remain undiſſolved behind. *Calcareous earth*, when mixed with this ſubſtance, is recognizable by the efferveſcence it produces, when a quantity of the diluted nitrous acid G. ſufficient to cover it, is poured upon it, and to the liquor filtered off from it, a few drops of the vitriolic acid F. are added, and a ſmall portion of the mixture is evaporated, in conſequence of which *genuine cryſtals of ſelenite* will fall by degrees to the bottom of the veſſel. (Exp. 23.)

III.

Uſe of the collection to Mineralogiſts.

The buſineſs of the mineralogiſt is, in the ſtricteſt ſenſe of the word, to examine or decompoſe *Earths* and *Stones*, in order to be able, rom their conſtituent parts, which he has by this

this means discovered, to point out their proper place in the particular system he follows. For this reason mineralogists must be acquainted with the different simple earths occurring in nature, viz. *calcareous*, *aluminous*, *magnesian*, *ponderous* and *siliceous earth**, with respect to their properties, and their action upon the different re-agents, in order to assure themselves of the presence of these substances; for, in all probability, it proceeds entirely from the very great variety of mixture in these primary component parts, which principally constitute the bases of the products of the mineral kingdom, that these latter shew themselves in such different forms, that they differ so much from each other in their external characters, and that the decomposition of them and the exact determination of the proportions of their component parts, are frequently so very complicated and laborious. Hence it follows, that a mineral is much easier to be investigated, when it consists merely of calcareous and siliceous earth, than when all the above-mentioned earths, and, besides these,

* *Klaproth's jargon earth*, as it is but seldom to be met with, cannot for the present be reckoned among the general earthy constituent parts of minerals.

inflammable matter, *iron* and *acids*, are contained in it.

Calcareous Earth.

A mineral, which conſiſts for the greateſt part of calcareous earth combined with fixed air, is to be diſſolved in nitrous or marine acid; the ſolution to be diluted with diſtilled water; that portion of ſiliceous earth, which may chance to be united with it, to be ſeparated from it by a filter compoſed of white blotting paper; and, laſtly, the calcareous earth is to be precipitated from the ſolution by means of the mild vegetable alkali O. In order to know whether there be any aluminous earth or iron in the maſs, it is neceſſary to pour upon the precipitate, after it has been well edulcorated and dried, ſome of the diluted acetous acid M. when the pure calcareous earth only will be diſſolved, and the aluminous earth and iron, that may chance to be preſent in the maſs, will remain undiſſolved behind. The liquid is to be filtered anew, and then the pure calcareous earth is to be precipitated with the ſolution of vegetable alkali O. The remainder is to be diſſolved in marine acid, and the iron it contains precipitated from it

with

with the lixivium of Pruſſian blue I. (Exp. 42.) The liquid is to be ſeparated by filtration; and, laſtly, the aluminous earth, it may chance to contain, is to be precipitated from it by the vegetable alkali O.

If *calcareous earth* occurs combined with *vitriolic acid in the form of gypſum*, a little of the mild vegetable alkali O. is to be poured upon a ſmall portion of it, and ſet by for ſome time in a warm place. The alkaline ſalt will unite with the vitriolic acid, and the calcareous earth with the fixed air, and in this ſtate they will be ſeparated from each other. The mixture muſt be ſuffered to ſtand for a conſiderable time in a warm place; and the water, that evaporates, muſt be replaced by freſh, till the decompoſition is completed. This being completed, the vitriolated tartar is to be waſhed well out of the maſs, with diſtilled water; after which ſome of the diluted acetous acid M. is to be poured upon the earth, by which means the ſeparated calcareous earth is diſſolved; and the gypſum, that may happen not to be perfectly decompoſed, remains undiſſolved behind, and may be ſeparated from the former by filtration. To

the filtered liquor a few drops of the lixivium of Pruſſian blue I. are to be added, in order to diſcover and ſeparate, purſuant to Exp. 42. the iron that may chance to be preſent; after which the calcareous earth, that is ſtill held in ſolution, is to be precipitated from it by means of the alkaline ſalt O.

Magneſia.

If *Magneſia* is the predominant ingredient in a mineral, it is beſt diſcovered by diſſolving ſuch mineral in the *vitriolic acid* F. Any calcareous earth, that may chance to be preſent, is converted into ſelenite; and earth of alum is known by the *aluminous taſte* which it imparts to the ſalt. The *ſiliceous earth*, if preſent, will remain undiſſolved behind, and *iron* may be ſeparated by the lixivium of Pruſſian blue I. purſuant to Exp. 42.

Aluminous Earth.

The ſeparation of *Earth of Alum*, from ſuch ſtones as conſiſt for the moſt part of this earth, is in like manner undertaken with the vitriolic acid F. when the earth uniting with the vitriolic acid forms alum. Any *ſiliceous earth*, that

may be preſent, remains undiſſolved behind, and *iron* is ſeparated purſuant to Exp. 42.

Ponderous Earth.

When *Ponderous Earth* occurs combined with fixed air, it may be treated in the ſame manner as calcareous earth. But this earth is particularly remarkable in this reſpect, that it has ſo great an affinity to the vitriolic acid, and forms with it a ponderous ſpar ſo difficultly ſoluble in water. If therefore ponderous earth occurs together with other earths diſſolved in an acid, and a few drops of the vitriolic acid F. are added, the latter unites with the ponderous earth (Exp. 83), and falls with it to the bottom of the veſſel; after which the other earths, that may ſtill happen to be preſent, may be ſeparated in the manner above mentioned. This earth generally occurs combined with vitriolic acid in the form of ponderous ſpar; and the former may be ſeparated from it in the moiſt way in the ſame manner as calcareous earth, by the mild vegetable alkali O. by means of a mutual affinity.

Siliceous Earth.

Siliceous Earth being inſoluble in all the acids, except the fluor acid, it may eaſily be ſeparated from minerals, as it will for this reaſon always remain undiſſolved behind. In other reſpects it may be diſtinguiſhed from the reſt of the earths, by its fuſing readily, when ſubmitted to the blow-pipe, with alkaline ſalts or fluxes, into a ſiliceous maſs or glaſs.

Minerals of a more mixed Nature.*

If, for inſtance, a mineral ſubſtance conſiſts of *Calcareous Earth*, *Magneſia*, *Gypſum*, *Siliceous*

* That it may be ſeen at one view, in how many different ways the products of the mineral kingdom occur mixed in nature; M. *Emmerling* has reduced into tables all the products of the mineral kingdom, hitherto chemically analyſed by *Bergman*, *Wiegleb*, *Kirwan*, *Achard*, *Klaproth*, *Weſtrumb*, *Heyer*, *Bayen*, &c. which tables M. *Hoffmann* has reviſed, enlarged, and enriched with notes. Theſe products are divided into three claſſes, *viz.* *Earths* and *Stones*, *Inflammable Subſtances*, and *Metals*; and theſe tables are to be found in the *Miner's Journal*, Year II. Vol. I. Part V. p. 417, under the following title: *A ſyſtematic Catalogue, in the Form of Tables, of all the ſimple Foſſils hitherto analyſed.* Beſides this, M. *Rembr*

ceous Earth, Iron, &c.; upon a ſmall quantity of this mineral, which has been previouſly reduced in the glaſs mortar to a fine powder, pour as much aqua regia as will cover it; which may be made of one part of the nitrous acid contained in the collection, and two parts of the marine acid. Now aqua regia will diſſolve all the conſtituent parts that are ſoluble in acids, viz. calcareous earth, magneſia, aluminous earth, and iron, and leave the inſoluble parts, ſuch as ſiliceous earth and gypſum, undiſſolved behind. After this, precipitate every thing out of the ſolution with the vegetable fixed alkali O. and put it upon a filter of white blotting-paper; when the liquid will run through the filter, and the earths, that were held in ſolution, remain behind; upon which

M. *Remler* has publiſhed a ſimilar table of ſuch earths and ſtones as have been inveſtigated, arranged in alphabetical order, under the following title: *A Table determining, in One Hundred Grains, the Proportion and Quantity of the component Parts of ſuch Stones and Earths as have been accurately analyſed of late; drawn up, ſo as to be ſeen at one View, for the Uſe of Natural Philoſophers, Mineralogiſts, Technologiſts, and Naturaliſts, by I. C. W. Remler. Erfurth,* 1790.

as much diſtilled water is to be poured, till it runs off from them quite taſteleſs. Now if upon this precipitate, when dry, a little of the diluted acetous acid M. is poured, and the mixture is ſet by in a warm place, the calcareous earth and magneſia, that are preſent in it, will be diſſolved in the acetous acid; but the aluminous earth and the iron will remain undiſſolved behind, which are to be ſeparated from it by filtration. The liquor that has paſſed through the filter evaporate to dryneſs, and pour a little of the vitriolic acid upon it: by this means the acetous acid will evaporate; but the vitriolic acid combining with the calcareous earth, that is preſent, will form ſelenite (Exp. 23), and, with the magneſian earth, Epſom ſalt. Upon that part which has been left undiſſolved by the acetous acid, pour a little marine acid, and it will be perfectly diſſolved in it: this ſolution dilute with diſtilled water, and add to it drop by drop the lixivium of Pruſſian blue, till no more blue precipitate is ſeparated from it (Exp. 42): but from the liquid, which remains after the ſeparation of this blue precipitate of iron, throw down the aluminous earth by means of the alkaline ſalt O. And now the

firſt

firſt reſiduum, which ſtill contains ſiliceous earth and gypſum, is to be examined. Pour upon it a little of the mild vegetable alkali O. and ſet it by in a warm place: the alkali will by this means, as was the caſe above with reſpect to the gypſum, combine with the vitriolic acid, and form vitriolated tartar, and the calcareous earth will be ſeparated. But this ſeparation taking place but ſlowly, the liquid, in caſe it is evaporated, muſt be replaced again by the addition of diſtilled water; and this muſt be repeated till ſuch time as the gypſum, that is contained in this mixture, is entirely decompoſed. The vitriolated tartar thus generated, and the uncombined alkali that may ſtill happen to be preſent, are now to be waſhed off, and the reſiduum to be dried: upon this reſiduum pour a little of the dilùted acid of vinegar M.: by this means the calcareous earth will be diſſolved, and the ſiliceous earth will remain behind in a pure ſtate. The calcareous earth may now be ſeparated from the vinegar, by precipitating it with the alkaline ſalt O.; and in this manner the whole mineral will have been decompoſed in *the moiſt way*. If this proceſs is conducted carefully, the quantity of the ſub-

ſtances

that are preſent may, if not completely, yet in ſome meaſure, be determined.

Some excellent inſtances of the analyſis of ſtones and earths are contained in *Bergman's* Works, as likewiſe in *Crell's* Chemical Annals by *Wiegleb*, *Klaproth*, *Weſtrumb*, &c. which ought to be conſulted on this ſubject: but beſides this M. *Weſtrumb* has brought together what is moſt neceſſary for this purpoſe, in an appropriate treatiſe, contained in his *Phyſico-chemical Eſſays*, vol. ii. part ii. Leipſic, 1788, p. 221; and vol. iii. part i. p. 319, under the following title: *A ſhort Introduction to the Chemical Analyſis of Stones and Earths in the moiſt Way.*

From the eaſy fuſibility of earths and ſtones, or from the property, which ſeveral of theſe bodies poſſeſs, of vitrifying in the fire, either alone or with the addition of ſalts, or even of earths of a different kind, the mineralogiſt is able in like manner to conclude variouſly of their conſtituent parts; and for this purpoſe ſmall trials with the blow-pipe are frequently ſufficient. In the inveſtigation of a mineral it is uſual to begin with this, and to determine what reſults the mineral gives, either by itſelf,

or

or with the fluxes contained in the collection, viz. *calcined borax*, *microcosmic salt*, and *mineral alkali*.

Now, as the bodies appertaining to the mineral kingdom, according to the so multifariously different mixtures of their constituent parts, afford also quite different results, when submitted to the action of the blow-pipe; it would be necessary to lay down here a whole system of mineralogy: but this being contrary to my plan at present, I beg leave merely to refer the reader to the following authors:

Gustavus von Engestroëm's Description of a Mineralogical Pocket Laboratory, and especially of the Utility of the Blow-pipe in Mineralogy; translated from the Swedish, and furnished with Notes, by M. Weigel. Greifswald, 1782.

Bergman, Comment. de Tubo ferruminatorio ejusdemque Usu in explorandis Corporibus, præsertim Mineralibus. Vindob. 1779. 8vo. *Opusc. Phys. & Chem.* vol. ii. p. 455.

Saussure's Improved Construction and Use of the Blow-pipe, in Crell's Supplements to the Chemical Annals, part ii. p. 1.

III. *Use*

III.

Uſe of the Collection to Metallurgiſts.

By means of Metallurgy, metals are ſeparated from the other ſubſtances with which nature has often combined them; and as this ſeparation in like manner depends upon chemical principles, the metallurgiſt alſo muſt be acquainted with the properties of metals, and particularly with their effects on the different re-agents, in order to aſſure himſelf of their preſence, and to know whether it be worth while or not to aſſay an ore in the moiſt way for metal. Now, in inveſtigations of this kind the ores muſt always be freed as much as poſſible from the earthy or ſtony particles that are mixed with them; for, the ſeparation being effected by ſolution in acids, theſe earths will be diſſolved at the ſame time, and render the inveſtigation difficult.

Gold.

Gold is to be diſſolved in no other way than in aqua regia, which may be compoſed, according to the preſcription given above, of nitrous and marine acid. Ores therefore which are

ſuppoſed

ſuppoſed to contain gold, are put into a quantity of aqua regia ſufficient to cover them; by which means the gold will be diſſolved, and the ſolution is to be diluted with diſtilled water. Now, if a few drops of a ſolution of tin * are added to this ſolution, the gold that is preſent will diſcover itſelf by a *violet-coloured precipitate* (the *purpura mineralis*, or mineral purple). This powder, when it is dried, and mixed with calcined borax, fuſes, when urged by the blow-pipe, to a glaſs of a *ruby colour*; and therefore alſo this powder is particularly made uſe of for the painting of genuine porcelain. Gold is beſides precipitated from its ſolution in a *metallic form* by pure martial vitriol diſſolved in diſtilled water.

* It is neceſſary that the ſolution of tin employed for this purpoſe be prepared with all poſſible care, particularly avoiding the leaſt degree of heat; on which account it is adviſable to ſet the phial, in which the ſolution is made, in cold water. The aqua regia muſt be mixed in due proportion, ſo as not to be immoderately ſtrong; and the tin, which ſhould be of the pureſt Engliſh ſort, muſt be added to it in ſmall portions only at a time. The phial in which the ſolution is performed, muſt be filled with the aqua regia up to one half or two thirds; and no freſh tin muſt be added, till the firſt portion is entirely diſſolved.

Platina.

Platina.

Platina in like manner is ſoluble in aqua regia only, and may be precipitated from it by a ſolution of ſal ammoniac. (For this purpoſe, diſſolve a little of the ſal ammoniac D. D. in diſtilled water.) By itſelf platina can be fuſed by the blow-pipe, by means of pure dephlogiſticated air only.

Silver.

Silver may be ſeparated from its ore by the nitrous acid G. and precipitated from it by marine and vitriolic acid in the form of *Luna cornea* and *Vitriol of Silver* (Exp. 88, 89, 90, 91). Copper precipitates it from its ſolution in a metallic form.

Copper.

Copper produces with the nitrous acid G. a *green*, and with the vitriolic acid F. a *blue* ſolution. If a little of the ſolution of volatile alkali P. is poured upon a ſmall portion of an ore that is ſuſpected to contain copper, it will be tinged blue by it (Exp. 72. 76. 127). The ſame may be ſaid of the ſolution of ſuch ore in the vitriolic or nitrous acid, when mixed with this ſalt. By poliſhed iron it is precipi-

tated from its ſolution in its *metallic form*. When fuſed by the aſſiſtance of the blow-pipe, it imparts a green colour to the flame.

Lead.

Lead, when contained in an ore, may be diſſolved by the acetous acid M. and forms with it a ſweetiſh *ſalt* (Sugar of Lead). Lead is more perfectly ſeparated from its ore by means of the nitrous acid; and from this ſolution it may be precipitated by the marine and vitriolic acids, or by the neutral ſalts compoſed of them, purſuant to Exp. 110 and 111. By the liver of ſulphur G. G. or the hepatic water H. H. it is precipitated of a *blackiſh-brown colour*. By zinc it may be ſeparated from its ſolution in its *metallic ſtate*. When urged with the blow-pipe, it froths up, and emits a yellowiſh light.

Tin.

Tin is diſſolved only in aqua regia, and by the nitrous acid G. it is corroded to a *white calx*. Expoſed to the action of the blow-pipe, it is eaſily calcined, and the different fluxes fuſe with it to a *white opake maſs*.

Iron.

Iron.

Iron produces with the vitriolic acid a *green*, and with other acids, the marine for inſtance, a *browniſh* ſolution, and the ſolution has a peculiar aſtringent *taſte of iron*. In the form of calx, in which form it uſually occurs in nature, it is diſſolved with difficulty by the vitriolic and nitrous acids, but more readily by the marine acid and aqua regia; and for this reaſon theſe latter acids are generally made uſe of, in examining a mineral containing much iron. By the vegetable alkali O. it is precipitated of a *greeniſh*, and by the lixivium of Pruſſian blue I. of a *blue* colour (Exp. 42): but the former of theſe precipitates aſſumes a *yellow* colour, on being dried in the air. With the aſtringent matter contained in vegetables, it produces a *black* colour (Exp. 48). To the different fluxes, when urged by the blow-pipe, a *green* colour is imparted by iron; but the longer it is calcined, the nearer do theſe approach to a *dark yellow hue*. Calcined iron, by urging it with a red heat on a piece of charcoal by means of the blow-pipe, is brought into a ſtate in which it is attracted by the magnet.

Mercury.

Mercury.

Mercury, as it generally occurs mineraliſed with ſulphur in the form of native cinnabar, is pretty readily recognizable by the red colour of this latter ſubſtance, beſides that it is difficult to ſeparate it in the moiſt way. Bergman* effected this by boiling the cinnabar with aqua regia; and when mercury has once been diſſolved by this means, its preſence may be diſcovered by the Experiments 35, 36. 104. Expoſed to the action of the blow-pipe, it ought to fly off entirely.

Biſmuth.

Biſmuth may be ſeparated from its ore by nitrous acid, and is precipitated from this ſolution, by the addition of diſtilled water only, in the form of a white calx. With microcoſmic ſalt or borax it fuſes, on being urged with the blow-pipe, forming a *glaſs-like maſs*, which, on being ſmelted upon a piece of charcoal, fumes, and emits a light.

Zinc.

Zinc in its mineraliſed ſtate is not readily diſcoverable in the moiſt way; but in its me-

* Opuſc. Phyſ. & Chem. vol. ii. p. 432.

tallic ſtate it is ſoluble in all acids, and by the ſpirit of wine I. I. it is gradually corroded in conſequence of a continued digeſtion, and converted into a white calx. When urged with the blow-pipe upon a piece of charcoal, it burns with a *blueiſh green* colour, and a white woolly calx is formed, called Flowers of Zinc. It gives a *yellow* tinge to copper in fuſion, and may be afterwards ſeparated from the copper again by means of quickſilver.

Regulus of Antimony.

Regulus of Antimony is extracted in combination with ſulphur by the cauſtic alkali N.; and from this ſolution it may be ſeparated in combination with the ſulphur, by any acid whatever. With concentrated marine acid it forms *Butter* or *Oil of Antimony*, and may be ſeparated from the acid in the form of a white calx (*Pulvis Algaroth*) by the addition of water only: its preſence alſo will be manifeſted by the Experiments 139 and 148. Expoſed upon charcoal to the action of the blow-pipe, it flies off in *white fumes*; and amidſt a ſucceſſion of bubbles depoſits beautiful flowers on the ſurface of any body that is held near it.

Regulus

Regulus of Arſenic.

Regulus of Arſenic imparts a *red* colour to ſulphur, and a *white* one to copper. Its calx (or white arſenic), when it is perfectly dephlogiſticated, acts like an acid. For the mode in which it may be diſcovered in liquids, ſee the Experiments 116, 117. 131. 138. 144. Expoſed to the action of the blow-pipe, it flies off with *white fumes of a garlic-like odour.*

Regulus of Cobalt.

The *Regulus of Cobalt* is ſoluble in the vitriolic and nitrous acid, as alſo in aqua regia. With the vitriolic acid it forms a *red ſalt.* The ſolution of it in aqua regia is of a *peach-bloſſom colour,* and, if evaporated, yields a ſaline reſiduum, which becomes *green* when it is made warm, and of which the colour *diſappears again,* as ſoon as this ſalt becomes cold. The latter property makes this ſolution fit to be uſed as a *ſympathetic ink.* It fuſes with borax, or any other flux, when urged by the blow-pipe, forming a *blue glaſs.*

Regulus of Nickel.

The *Regulus of Nickel* imparts, like copper, a *blue* colour to the cauſtic volatile alkali P.; but with the vitriolic acid F. it produces, inſtead of a *blue*, a *green* ſolution. By calcining the vitriolic ſalt of Nickel, not a *browniſh red* but a *green caput mortuum* is yielded; and it forms with borax or microcoſmic ſalt, when urged with the blow-pipe, not a *green* but a *hyacinth-coloured glaſs*. If it contains arſenic, it is volatilized, ſo as to produce vegetations in the form of trees.

Manganeſe.

Manganeſe is diſtinguiſhed by its dephlogiſticating the marine acid, and producing a *black calx*, when urged with the blow-pipe. Fuſed to glaſs with borax or other fluxes by means of the blow-pipe, it yields *with the point of the flame* a *red glaſs*, which with the interior part of the flame becomes *white* again.

On the ſubject of aſſaying of ores *in the moiſt way* may be conſulted, the Eſſays in *Bergman's* Opuſc. Phyſ. & Chem. vol. ii. entitled, *De Precipitatis Metallicis*, p. 349, and *De Minerarum Docimaſia Humida*, p. 399.

On

On the arts of aſſaying and ſmelting in general may be conſulted, *Gmelin's Chemical Elements* of the Arts of Aſſaying and Smelting.

IV.

Uſe of the Collection to Technologiſts, or Projecting Artiſts.

The Technologiſt occupies himſelf in ſearching after and inveſtigating the various productions of nature—not in order to arrange them in a convenient ſyſtem, but with a view to improve and manufacture them to the advantage of the country he lives in, and to render them of general utility. And as in theſe days many productions, improved by art for the convenience of mankind, are become articles of indiſpenſable neceſſity, they are now manufactured in every country. But between theſe artificial productions there is, for the moſt part, a great difference diſcoverable with reſpect to their goodneſs and perfection; and when this difference is accurately inveſtigated, the cauſe of it is found to conſiſt merely in the genuineneſs and purity of the materials which have been employed in the manufacturing of them, or in

the mutual proportion of their conſtituent parts. Now the genuineneſs of the materials, as well as the proportions to be taken, in order to make the products of our own country reſemble thoſe of foreign regions, we diſcover by means of chemical reſearches. By theſe we find whether the abſence or the preſence of a conſtituent part is the cauſe of ſuch difference; and by theſe likewiſe we are enabled to correct as well the one defect as the other. Moſt of the caſes, mentioned in the preceding pages, are objects of inveſtigation for Technologiſts. The inveſtigation of *waters*, the examination of *wines*, the analyſing of *earths* and *ſtones*, the diſcovering of *metals*, the knowledge of *ſalts* and their genuineneſs, are all fit objects for Technologiſts: I need therefore only refer to the inſtances given above.

On the ſubject of Technical Chemiſtry may be read:

Gmelin's Principles of Technical Chemiſtry. Halle, 1786.

Succow's Outlines of Oeconomico-technical Chemiſtry. The ſecond edition, enlarged. Leipſic, 1789.

V.

Uſe of the Collection to Manufacturers.

The Manufacturer is diſtinguiſhed from the Technologiſt, or Projecting Artiſt, in this reſpect, that this latter endeavours to improve all the materials produced by nature, while the Manufacturer uſually confines himſelf to a ſingle article only. Now, if he would not wiſh to treat them as a mere workman, but bring the productions he manufactures continually nearer and nearer to perfection, he muſt in like manner very often have recourſe to Chemiſtry. Indeed, it is for the moſt part owing to trivial circumſtances, that many proceſſes miſcarry under his hands: but it is particularly important for him to know, whether the *water* he uſes in his buſineſs be ſufficiently pure, or in how far or with what ſubſtances it is contaminated, and what influence this can have upon the better manufacturing of his materials. It is alſo of importance to him, to obtain the *materials* he uſes in as pure a ſtate as poſſible, or to bring them, by previous proceſſes, to the requiſite degree of purity. The Silk-dyer, for

inſtance, is well aware, what a favourable influence the *purity of the water* and that of *his moſt neceſſary materials* have upon the ſucceſs of his dye: and thus, again, there is a whole ſeries of proceſſes beſides, in which particular reſpect muſt be had to this object. An extremely pure water may be diſcovered by Exp. 40. 46. 49. 53. 55. 62. 67. 73. 77. 82. 87. 95. 103. 109. 115. 118. 121. 125. 134. 136. 142: and how the noxious admixture is to be found out, and, if poſſible, ſeparated from it, the Experiments deſcribed above will, in general, inform him. Inſtructions for diſcovering the genuineneſs of the materials neceſſary for his purpoſe, *viz.* VITRIOLIC ACID, NITROUS ACID, MARINE ACID, VINEGAR, SALT OF TARTAR, MINERAL ALKALI, VOLATILE ALKALI, GLAUBER'S SALT, SALTPETRE, SAL AMMONIAC, ALUM, BORAX, CREAM OF TARTAR, WHITE VITRIOL, CORROSIVE SUBLIMATE, SUGAR OF LEAD, BLUE VITRIOL, QUICKSILVER, CINNABAR, WHITE LEAD, RED LEAD, TIN, VERDIGRISE, IRON, MILK OF SULPHUR, &c. have been already given above.

The above-mentioned Treatiſes upon Technical Chemiſtry, by *Gmelin* and *Succow*, I recommend

commend likewiſe to the attention of the Manufacturer.

VI.

Uſe of the Collection to Farmers.

It is well known to the practical Farmer, how much depends upon the goodneſs and proper mixture of the ſoil, with reſpect to promoting the growth of plants. Soils are generally divided, with reſpect to their conſtituent parts, into *chalky*, *clayey*, *ſandy*, and *mixed ſoils*. Now, of theſe, that which is properly mixed is preferable to the others. *A chalky ſoil* is not the moſt fertile, as it is heavy, and prevents the ſpreading of the ſmall fibres of the root: it is penetrated but ſlowly by moiſture, but retains it afterwards ſo much the longer. *A clayey ſoil* is ſoon penetrated by water, but retains it too long, and does not allow it to drain off again ſlowly. It is heavy at all times; and when at length it is entirely dried up, it becomes too hard, and cracks. *A ſandy ſoil* abſorbs water readily, but parts with it again too ſoon. It alſo receives more heat than another ſoil, and for this reaſon is at moſt times deficient in moiſture, But a well *mixed ſoil*,

ſoil, which ought to conſiſt of about equal parts of *lime*, *clay*, and *ſand*, uſually poſſeſſes all the good qualities of a ſoil united. It abſorbs moiſture readily, does not retain it too long, nor prevent the ſpreading of the ſmall fibres of the root, neither does it crack. But as the proper proportion of a ſoil cannot be diſcovered otherwiſe than by chemical inveſtigation; on this account it is requiſite for the cultivator of land to poſſeſs ſome knowledge of chemiſtry, and particularly of the effects and properties of the re-agents occurring in this collection. Now, in order to aſſure himſelf, by means of theſe re-agents, of the component parts of the ſoil he occupies, he has no more to do than implicitly to follow the analyſis of *earths and ſtones*, which has been indicated above in the chapter explaining the uſe of this Collection to Mineralogiſts; for which reaſon it would be ſuperfluous to repeat them in this place. As an imitable pattern of Analyſes relative to this ſubject, may be read,

Andrea's Treatiſe concerning a conſiderable Number of Earths found in His Majeſty's Hanoverian Dominions, &c. and their Uſe to the Huſbandman. Hanover, 1769.

But

But the rural œconomiſt may meet with many other occaſions beſides, in which the reagents contained in the Collection may be of ſervice to him. Linen and clothes, for inſtance, are frequently, in the courſe of houſekeeping, liable to be ſoiled by *greaſe*, *wine*, *iron* and *ink*; and the removal of theſe ſpots depends in like manner upon chemical principles.

To take Spots out of Linen.

In order to take *ſpots of greaſe* out of linen, the ſpots are to be moiſtened with a few drops of the vegetable alkali N. rubbed between the fingers, and then waſhed out immediately. Here the alkali, uniting with the greaſe, will form a ſoap, which may be then waſhed out with water.

Stains made by *red wine* may be taken out by means of a weak acid. A little of the *nitrous*, *marine*, or *acetous acid* contained in the Collection is to be diluted with twice its quantity of water, and the ſpot moiſtened with it; and, after being rubbed a little between the fingers, to be waſhed out immediately with water. In caſe all the colour produced by the wine does not entirely

entirely disappear in consequence of the first application, the operation is to be repeated a second, or even a third time, till the stain is entirely gone.

Iron-moulds are removable by means of the marine acid contained in the Collection. The spot is to be moistened with it, rubbed between the fingers, and washed out with clean water. The iron-mould or rust is dissolved by the acid, and the spot disappears.

Ink spots are best taken out by the nitrous acid G. This is to be diluted with four times its quantity of water, and the spot moistened with it, which is then to be rubbed between the fingers, and washed out immediately.

Cleaning of dyed Woollen, Silken, and other Stuffs.

Dyed cloths and stuffs require far more attention than uncoloured linen or cotton does, because in the former the object is not only to take out the spot, but also to preserve the colour. These cloths or stuffs may be soiled by *grease*, *wine*, *vinegar*, *lemon-juice*, or *an alkaline liquor*. *Spots of grease* may be taken out by the *spirit of wine* I. I. by moistening the spot carefully with it, and, after rubbing the part gently, washing

waſhing the ſpot out with clean water. If the greaſe has already taken too faſt hold of the cloth, it may firſt be diluted with a few drops of oil of turpentine, and then be taken out with ſpirit of wine. But ſtains occaſioned by *vinegar*, *lemon-juice*, or *wine*, require far greater attention. In ſuch colours as conſiſt chiefly of materials that are changed by acids or alkalies, the production of ſuch ſpots, as well as the removal of them, depends upon this action. If the ſtain was made by *wine*, *vinegar*, or *lemon-juice*, the acid has in this caſe produced the change and the ſpot: now, if the acid be taken away again carefully by alkaline ſalts, with which it is moſt inclined to unite, the ſpot muſt diſappear likewiſe. But here it is neceſſary previouſly to inquire, whether the alkaline ſalt too, that is to be employed, will not deſtroy the unchanged colour, and produce a new ſpot. Now, in order to take out ſpots of this kind, mix about ten drops of the *cauſtic volatile alkali* P. with twenty drops of the ſpirit of wine I. I.: with this mixture wet a clean linen rag, and rub the ſpot with it carefully. If the ſpot is occaſioned by *alkaline ſubſtances*, a little of the acetous acid M. may be diluted with water,

water, a clean rag wetted with it, and the proceſs be carried on in the ſame manner as directed above.

To any one who is deſirous of reading any thing more on the ſubject of theſe inquiries ſo highly uſeful to all who are occupied in agriculture, as well as to the maſters and miſtreſſes of families, and of the appearances that occur in the courſe of theſe ſame inquiries, I cannot recommend a better book, or one in which perſpicuity and brevity are more happily united, than the elementary treatiſe above mentioned of *Succow*.

VIII.

Uſe of the Collection to the Cultivators of Natural Philoſophy.

Thoſe who ſtudy Chemiſtry merely from motives of curioſity will, by repeating the experiments pointed out in this Treatiſe, find ſufficient opportunity of amuſing themſelves, not only in a very inſtructive, but alſo in a moſt pleaſing manner. As this Cheſt, on account of its commodious arrangement, is very convenient to take with one in travelling; ſuch perſons in particular as are uſed to viſit water-

ing-places will have frequent opportunity of making themſelves acquainted with the products which nature has frequently in various ways beſtowed, and that ſometimes even with a laviſh hand, upon theſe ſpots. By means of the many different changes of colours, that take place in colourleſs liquids, when combined with other ſubſtances, a great variety of amuſing experiments alſo may be made, which, if they are not undertaken entirely without thought or deſign, may prove uſeful and inſtructive. In order to avoid increaſing the bulk of this Treatiſe, I ſhall forbear to point out here the many inſtances that might be given of this; but refer thoſe who are deſirous of acquiring information on this ſubject, to the *Chemical Tricks and Deceptions*, collected by *Wiegleb* and *Roſenthal*, in the Firſt, Second, and Third Parts of *Wiegleb's Natural Magic*.

THE END.